4.2 Screw piling

We understand that a screw piling rig will be used for the piles nearest to the neighbouring buildings. This process involves using steel casing with a screw tip to place the casing. Once the casing is at the required depth, a drilling auger mounted on the Piling Bauer BG25 drilling rig will be used to extract the contents of the pile before a prefabricated pile reinforcing cage is lowered and filled with concrete. During the concrete filling process, the casings are to be removed using a vibratory hammer. Each screw pile operation is expected to take between 1 – 1.5 days to complete, depending on the ground conditions.

The NVMP states the following sound power levels for the equipment outlined above:

- Bauer BG25 drilling rig – 112 dB L_{wA} during screw piling and augering
- Crane for piling – 93 dB L_{wA} while lifting the casing and steel cages
- Cement mixer – 101 dB L_{wA} while discharging cement

Considering the above sound powers and mitigation proposed, any works within the following distances of the neighbouring sites would result in noise levels above 70 dB L_{Aeq}:

- Bauer BG 25 drilling rig – 14 metres
- Crane for piling – 9 metres
- Cement mixer – 20 metres

We understand that the crane used to lower the reinforcing cage and the cement mixer are both able to be located so that the equipment will not be required to operate within their respective off-set distances.

Based on figure 1.1, there will be seven locations where screw piling operations will be undertaken in close proximity to the property boundary and façade of Building A, some of which will result in noise levels of over 90 dB L_{Aeq} at the building façade.

As stated above, the noise from the upper rotary parts of the rig will be enclosed with an acoustic sleeve, that will provide a noise reduction of 14 dB. These rotating parts are expected to be located directly above the pile, which will locate it within 1 metre of the boundary and the façade of Building A. With a 20 dB reduction for closed windows, noise levels of up to 76 dB L_{Aeq} could be experienced within the adjoining tenancies of the building. The seven piles along the common boundary are expected to take seven days to complete.

Based on a review of the internal floor plans of the building, tenancies 0.7 (ground floor office space) and 1.2 (photography studio) are expected to receive noise levels above 80 dB L_{Aeq} on the external walls of their tenancies over a four day period, as the works proceed along the façade. This will likely result in internal noise levels over 60 dB L_{Aeq}. Tenancies 0.6 (art studio), 2.1 (vacant) and 0.5 (residential) will receive external noise levels of over 80 dB L_{Aeq} for a two day period. Tenancy 2.2 (office) will receive noise levels over 80 dB L_{Aeq} for three days.

The ICE 23RF vibratory hammer will be used to remove the pile casing while the pile is filled with concrete. This is expected to also result in very high noise levels against the façade of Building A. With a 20 dB reduction from closed windows, internal noise levels of 80 dB L_{Aeq} could be expected in the adjoining spaces. These noise levels are expected to only be present while the vibratory hammer is operating directly outside of the windows, and as stated above, the screw piling operations closest to the building are expected to take seven days to complete, with the process to remove the pile casing expected to be only a small part of the operation.

Since noise levels are likely to exceed an internal noise level of 55 - 60 dB L_{Aeq} inside these spaces when screw piling occurs in the closest locations this will likely be disruptive for typical office type activities. We

recommend that the occupants of these buildings are given advance notice before the screw piling begins, and kept updated of the likely timing and duration of this activity. Given the short duration of this activity it may be possible to avoid times of particular sensitivity to the occupants (for example start closest locations early in the day before buildings are occupied).

There are tenancies in this building (for example 2.2, office space) which appear only to have limited window areas which would overlook screw piling activity. Given the remaining façade is a heavier brick facade, in these particular cases, it may be practical to consider installing Soundex Noise Control curtains over windows to reduce internal noise levels. This could be discussed during the consultation process.

Some of the screw piles closest to the buildings across Robson Alley will be within the 14 metre setback for the drilling rig outlined above. However, noise levels incident on the closest façades (when excluding façade reflections) will generally be 70 dB L_{Aeq} or less, and therefore internal noise levels are expected to remain below 50 dB L_{Aeq}. There is also a pile with methodology to be determined, approximately 7.5 metres from Building A. If a screw piling methodology is used in this location, then noise levels on the façade of Building A will be 73 dB L_{Aeq}, and internal noise levels are expected to remain below 53 dB L_{Aeq}.

4.3 Vibratory case piling

We understand that the majority of the piling sites located closer to the south-eastern boundary of the site will use vibratory case piling. This will involve the use of the ICE 23RF vibratory hammer, crawler crane, and power unit as described above. Again, once the piles are at the required depth, the Bauer BG25 drilling rig will be used to extract the contents of the piling before the reinforcing cage is lowered into the pile casing and it is filled with concrete.

The offset distances where noise levels above 70 dB L_{Aeq} are expected for the above activities have been provided in Section 4.1 and 4.2.

Based on figure 1.1, the closest two vibratory piles to Building B and the closest piles to Building A (one with methodology to be determined) could require the vibratory hammer to be used within the 15 metre setback described above. External noise levels incident on the façade of Building B would be 75 dB L_{Aeq} for the closest pile location, and 77 dB L_{Aeq} at the façade of tenancies 0.5 (residential) and 2.3 (office space) of Building A, if a vibratory case piling methodology is confirmed. This is likely to result in internal levels in the order of 55 dB L_{Aeq} for the closest Building B spaces, and 57 dB in the closest Building A spaces based on a 20 dB reduction with windows closed.

4.4 Vibratory roller and plate compactor

We understand that the top 300 mm of the site will be removed by an excavator, with the removed material being replaced with a compacted engineering fill to be used as a platform for the piling operations. The compaction of this fill will use an 8t vibratory roller and a 500 kg plate compactor. We understand that it is intended to use the vibratory roller centrally on the site with the plate compactor being used on the areas closest to the boundaries. The NVMP states the following sound power level for this equipment:

- 500 kg plate compactor – 106 dB L_{wA}
- 8t vibratory roller – 101 dB L_{wA}

Because the vibratory roller is expected to be quieter and will not operate as closely to the boundaries, we have focussed our assessment on the plate compactor.

Based on the above sound power, sustained operation of the plate compactor in one location, without screening, within 34 metres of neighbouring sites will result in noise levels above 70 dB L_{Aeq} at one metre from building facades.

At the buildings across Dowling Street, screening will be provided by the proposed site hoardings when the plate compactor is close to the boundary. At upper levels, screening will only be provided when the compactor

is within 2 – 5 metres of hoardings. However, even when operating at a low speed of travel, in the order of 1 – 2 metres per minute, we expect noise associated with the plate compactor will not be sustained for sufficiently long to exceed 70 dB $L_{Aeq\ (15\ min)}$ across Dowling Street.

Taking into account that the plate compactor could be operating as close as practical to the façade of Building A, and the reduction provided by site hoardings for this low source (generally to ground floor tenancies only), noise levels in the order of 96 dB L_{Aeq} may be expected on the closest ground floor and first floor facades of Building A (tenancies 0.7, 0.5, 1.2, 2.2, 2.3). Lower noise levels of 85 dB L_{Aeq} or less would be received at tenancy facades inset from the site boundary (tenancies 0.6 and 2.1).

We expect that this will result in worst-case internal noise levels of up to 76 dB L_{Aeq} for the closer tenancies. Since the plate compactor is a moving source, this represents a snapshot of the likely noise levels as the compactor completes a pass. The impact of this noise will be dependent on the speed of the plate compactor, and the length of time that it will be operating directly in locations close to the building. We note that the NVMP states that *"compactors will be throttled down gently and will track as slowly as is practicable".*

At Buildings B, C, D, F, and G the plate compactor could be operating up to the boundary of the applicant site that follows Robson Alley. When the plate compactor is operating close to this boundary, we expect that worst-case noise levels will be 87 dB L_{Aeq} on ground floor façade areas, and 83 dB L_{Aeq} on the closest upper facades where there is line of sight to the compactor. With a 20 dB reduction for closed windows, this would result in internal noise levels of 63 – 67 dB L_{Aeq} when the plate compactor is operating nearby. As discussed above, the plate compactor is a moving source, and this represents a snapshot of the likely noise levels as the compactor completes a pass. The impact of this noise will be dependent on the speed of the plate compactor, and the length of time that it will be operating nearby.

Since noise levels are likely to exceed an internal noise level of 55 – 60 dB L_{Aeq} inside these spaces when compacting occurs in the closest locations this will likely be disruptive for typical office type activities. We recommend that the occupants of the relevant spaces in these buildings are notified before the compacting begins, and kept updated of the likely timing and duration of this activity. Given the short duration of this activity it may be possible to avoid times of particular sensitivity to the occupants (for example start closest locations early in the day before buildings are occupied).

There may be tenancies in Building A (for example 2.2, office space) which appear only to have limited window areas which would overlook this activity. Given the remaining façade is a heavier brick facade, in these particular cases, it may be practical to consider installing Soundex Noise Control curtains over windows to reduce internal noise levels. This could be discussed during the consultation process.

4.5 Tracked excavators

As outlined above, excavators will be used to remove the top 300 mm of the site. The Ground Works NVMP outlines that two size of tracked excavators will be used for this, the two sizes and their associated sound powers as indicated are as follows:

- 13t tracked excavator – 96 dB L_{wA} during site scraping, 100 dB L_{wA} during demolition and loading, and 95 dB L_{wA} during earthworks
- 20t tracked excavator –104 dB L_{wA} during site scraping, 105 dB L_{wA} during demolition and loading, and 97 dB L_{wA} during earthworks

Based on the above sound powers, the 13t excavator would result in noise levels above 70 dB L_{Aeq} if it operates within 12 metres (scraping), 18 metres (demolition and loading) and 10 metres (earthworks) of neighbouring buildings. The larger 20t excavator would result in noise levels above 70 dB L_{Aeq} if it operates within 28 metres (scraping), 30 metres (demolition and loading) and 12 metres (earthworks) of neighbouring buildings.

This indicates that excavator activity in many areas across the site can comply with the 70 dB L_{Aeq} limit. While the sound power for the 13t excavator is lower, we understand that it will be used for works within 10 metres of adjoining buildings. Because of this, the highest noise levels incident on building facades are likely to be

from the smaller excavator and are presented below. For completeness, we note that when the larger 20t excavator is scraping or undertaking earthworks when 10 metres setback from a building, noise levels in the order of 69 – 76 dB L_{Aeq} may be received on the building façade.

When the 13t excavator is undertaking site scraping works close to Building A, noise levels in the order of 82 dB L_{Aeq} are expected at the closest building facades. When this is the case, we expect that worst-case internal noise levels up to 62 dB L_{Aeq} could be expected based on a 20 dB reduction with windows closed. The impact of this noise will be very dependent on the time that this excavator will be operating close to this façade.

When the 13t excavator is undertaking site scraping works across Robson Lane from Buildings B, C, D, F, and G, we expect that worst-case noise levels of up to 76 dB L_{Aeq} could be experienced on the closest parts of these building facades. This is likely to result in internal noise levels of up to 56 dB L_{Aeq} based on a 20 dB reduction with windows closed.

Since noise levels are likely to exceed an internal noise level of 60 dB L_{Aeq} inside some tenancies of Building A, this will likely be disruptive for typical office and communication activities. Lower internal noise levels of up to 56 dB L_{Aeq} are predicted for the closest spaces in Buildings B, C, D, F and G, and noise at this level is likely to be dominant, and potentially disruptive to normal day-to day activities. We recommend that the occupants of relevant spaces in these buildings are advised before the excavators operate close to the building, and kept updated of the likely timing and duration of this activity. Given the short duration of when these operations will be in close proximity it may be possible to avoid times of particular sensitivity to the occupants (for example start closest locations early in the day before buildings are occupied).

There may be tenancies in Building A (for example 2.2, office space) which have limited window areas which would overlook this activity. Given the remaining façade is a heavier brick facade, in these particular cases, it may be practical to consider installing Soundex Noise Control curtains over windows to reduce internal noise levels. This could be discussed during the consultation process.

4.6 Concreting activities

We expect that the main noise generating activities associated with concrete activities on site will be the pumping and pouring of concrete, and the use of power floats on the slabs.

4.6.1 Concrete pumping and pouring

Noise data has been sourced from BS 5228-1:2009, which states that typical concrete trucks and pumps have a sound power of up to 101 dB L_{wA}. It is expected that the truck would typically be able to be operated at least 20 metres from the nearest measurement point on all sites and the noise level without any site fencing will be 70 dB L_{Aeq}. For concrete pumped to higher levels the sound power of the pump will be louder. For example, for concrete pumped to the second floor the sound power is expected to be 109 dB L_{wA} and in this situation the concrete pump truck would need to be located 48 metres from surrounding building facades to achieve the 70 dB L_{Aeq} limit. Because of the size of the site, this is unlikely to be practical and it is recommended that localised acoustic screening be used around the concrete pump to reduce the line of sight to the surrounding building facades as much as is practical. With screening achieving an 8 dB reduction, the required setback would reduce to 19 metres.

For completeness, if there are occasions where it is not practical to achieve the above setbacks or screening, then noise levels will be higher. For a concrete truck/pump operating 10 metres from the façade of a neighbouring building, unscreened noise levels will be in the order of 73 dB L_{Aeq} (pumping to ground level) to 81 dB L_{Aeq} (when pumping to upper levels). This is likely to result in internal noise levels in the order of 53 – 61 dB L_{Aeq} for the closest spaces based on a 20 dB reduction with windows closed.

4.6.2 Concrete floating

Once the slabs have been poured, a concrete power float will likely be used on the setting slab. While the overall noise levels of the specific equipment on site will vary (due to the noise of the concrete floats available), we have based our analysis on a handheld power float, with a sound power of 100 dB L_{wA} based on the data within BS 5228-1:2009. With no localised screening in place when the float is operating at least 18 metres from the surrounding buildings then the noise levels are expected to be less than 70 dB L_{Aeq}. With localised screening this distance is expected to reduce to 6 metres. Based on the layout of the proposed buildings, the float is expected to operate as close as 1.5 metres from the Building A façade close to tenancies 0.7 (office) and 1.2 (photography studio). At this distance, worst-case noise levels of 88 dB L_{Aeq} are expected at the closest points of the façade. Since this is a moving source, this represents only a snapshot of the likely noise levels as the concrete float passes. While internal noise levels in the closest spaces could be as high as 68 dB L_{Aeq} at worst case points, this is likely only to occur for a relatively brief period.

A power float could operate as close as 3.8 metres from the nearest Building D, F and G facades when forming staff carpark areas on the ground floor. Noise levels of up to 80 dB L_{Aeq} would be expected at upper levels of these buildings when this occurs. We note that at the first floor and above, the building is setback much further from Robson Alley. Since this is a moving source, this represents only a snapshot of the likely noise levels as the concrete float passes. While internal noise levels in the closest spaces could be as high as 60 dB L_{Aeq} during the closest works, this is likely only to occur for a relatively brief period.

4.7 Heavy Vehicles

The noise level arising from heavy vehicle movements is difficult to quantify due to the large variance in vehicle noise characteristics and the intermittent nature of the activity. We consider that the best approach to reducing the noise levels from construction vehicles both on and off site would be through operational measures outlined within a Construction Noise and Vibration Management Plan, as follows:

- Limitations on the arrival and departure times of heavy vehicles to between 0730 – 1800 hours Monday to Saturday.
- Prohibit the use of engine braking within the vicinity of the site.
- Limit the sound level and frequency of use of vehicle reversing beepers.
- Limit the amount of time vehicles spend idling on site.
- Prohibit the use of vehicle horns on site except for safety purposes.

The location of the site access is unknown, although we recommend that, as far as practical, the main site access is located away from nearby buildings.

4.8 Cranage

Based on the size of the development, we expect that at least one crane will be required as part of the general site works during construction.

We expect that both tower and mobile cranes could be used, and so our assessment is based on a worst-case scenario where a mobile crane is used on site. Based on the values given in BS 5228-1:2009, for typical cranes which may be used on site (12 – 100 tonne), a worst-case sound power of 95 dB L_{wA} has been used. Based on this assumption, noise from a crane operating 10 metres or more from any boundary would comply with the 2GP construction noise limits.

For completeness, if there are occasions where it will not be practical to operate the crane more than 10 metres from a nearby building, then noise levels will be higher. For a typical crane operating five metres from the façade of a neighbouring building, noise levels will be in the order of 73 dB L_{Aeq}. This is likely to result in

internal noise levels in the order of 53 dB L_{Aeq} for the closest spaces based on a 20 dB reduction with windows closed.

4.9 Envelope and internal fitout

We note that some activities involving power tools that will occur on site will generate high noise levels for shorter periods, for example the use of angle grinders and skill saws. We have considered a sound power level of 105 dB L_{WA} for this type of activity, operating for a total of two minutes in a typical 15 minute assessment period. Based on this, if angle grinders and the like are used more than 11 metres from the neighbouring occupied buildings, compliance with the 70 dB L_{Aeq} limit would be expected.

We expect that for the majority of the time, these types of activities can occur more than 11 metres from the surrounding building façades given the location of the proposed building on site. If any louder power tools will be used for sustained periods closer than 11 metres to the facades of adjoining buildings, the activity should be acoustically screened to remove the line of sight to ensure compliance. These types of activities appear unlikely to occur close to the façade of buildings across Robson Alley, but may occur close to Building A. For completeness, if it is not practical to screen these activities when they occur close to Building A, then noise levels will be higher, potentially up to 80 dB L_{Aeq}. This could result in internal noise levels up to 60 dB L_{Aeq} for the closest spaces based on a 20 dB reduction with windows closed.

Once the building is enclosed and internal fitout works begin, typically construction noise levels will reduce due to the screening from facades and are likely to be less than 60 dB L_{Aeq} at the closest building facades.

4.10 Cumulative noise

The construction processes described above are expected to occur in sequence, and not simultaneously. The activity noise levels presented above also typically represent the worst-case noise levels when a key activity occurs close to the boundary.

The exception to the above is that the cement truck will be operating at the same time as the vibratory hammer is being used to extract the pile casing. As the cement truck is expected to operate centrally on the site and be well outside the minimum set-back distance, the noise from the vibratory hammer is expected to dominate the noise received at the façades of the surrounding buildings.

5.0 SUMMARY OF NOISE EFFECTS

In this section we discuss the likely noise effects for the closest buildings based on the predicted noise levels presented in section 4.0 above and discussion on likely noise effects in section 2.3.

Building E and the buildings on the opposite side of Dowling Street are expected to receive noise levels below 70 dB L_{Aeq} for the majority of activities occurring on the site, due to the distance they are setback from the site and key noise generating activities. This is also the case for the top levels of Buildings D and F with Princes Street frontage, which are located between 21 and 35 metres from the site boundary. There may be an occasional activity which exceeds the construction noise limit of 70 dB L_{Aeq} for brief periods, for example a large excavator scraping near the Dowling Street site boundary, although noise levels at the façade of these buildings are expected to remain below 75 dB L_{Aeq}. For these buildings, we consider that noise effects are likely to be less than minor as day-to-day activities are likely to be possible with minimal disruption.

Many spaces within Buildings B, C, D, F and G have a small setback across Robson Alley. A small excavator scraping, or concrete floating activities may generate noise levels between 76 – 80 dB L_{Aeq} on the closest façades of these buildings for relatively short durations. Sheet piling activity is expected to generate noise levels of 83 dB L_{Aeq} on the closest facades of these buildings (except Building B) for a period of one to three days. Plate compaction activity close to the boundary may also generate noise levels between 83 dB L_{Aeq} (ground floor) and 87 dB L_{Aeq} (upper levels) for the periods when it is operating close to the boundary. While there are some works at these buildings which are likely to be disruptive to work and communication, requiring occupants to change their behaviour, these are only expected to occur for relatively short durations. We consider this likely to result in a minor noise effect at these buildings.

Building A is located against the boundary of this site and there are several activities which are expected to generate very high noise levels above 80 dB L_{Aeq} at building facades, some at 90 dB L_{Aeq} or more. The types and durations of activities predicted to exceed 80 dB L_{Aeq} are summarised in table 5.1 below.

Table 5.1 – Activities likely to generate more than 80 dB L_{Aeq} at Building A facades

Activity	Level and comment on duration	Tenancies
Sheet piling	Up to 90 dB L_{Aeq} for less than one day	Tenancies 0.7 (office) and 1.2 (photography studio)
Screw piling	Up to 90 dB L_{Aeq} for four days	Tenancies 0.7 (office), and 1.2 (photography studio)
	Up to 90 dB L_{Aeq} for two days	Tenancies 0.6 (art studio), and 0.5 (residential)
	Up to 90 dB L_{Aeq} for three days	Tenancy 2.2 (office)
Plate compaction	85 – 96 dB L_{Aeq} when close to boundary. Moving source so will not be constant at these levels.	All overlooking tenancies
Site scraping	82 dB L_{Aeq} when close to boundary	All overlooking tenancies
Concrete float	88 dB L_{Aeq} when close to site boundary. Moving source so will not be constant at these levels.	Tenancies 0.7 (office) and 1.2 (photography studio)

Noise from works at these levels is likely to be disruptive in the closest tenancies of Building A when they occur. Some of these activities, such as compaction, power floating and site scraping are likely to be relatively transient and won't be maintained at the predicted noise levels at any one tenancy for long periods of time. Since the cumulative number of days when tenancies in this building are likely to receive noise levels above 80 dB L_{Aeq} totals a period of week or more, we recommend tenants within this building are adequately consulted to devise methods to reduce this effect as far as possible and given advance warning of key works. Since works at this level only occur for limited periods of the total construction timeframe (and building life), this will ensure noise effects are only minor, on average.

We note that predicted levels associated with concrete pouring, cranage and envelope /internal fitout have not been discussed in this section. We generally expect it will be practical for these activities to meet the daytime construction noise limit of 70 dB L_{Aeq} with suitable attention to site location and screening by the contractor as discussed previously. Worst case noise levels have been provided above, should there be occasions where it will not be practical to maintain recommended setbacks or screening. We note that the levels predicted are either of a lower order (for the crane), or activities likely to be sustained for shorter periods (i.e. loud power tools very close to the boundary) when compared to other key sources discussed above.

6.0 CONCLUSIONS

AES have been engaged to provide acoustic engineering advice relating to Construction Noise Effects for the ACC development. We have discussed construction noise effects associated with ground work activities which have been identified as exceeding the District Plan construction noise limits for the ACC development, as well as activities associated with the remaining building construction phases.

6.1 Appropriate noise levels

Compliance with the long-term daytime construction noise limits of 70 dB L_{Aeq} and 85 dB L_{AFmax} outlined in the District Plan and NZS 6803:1999 will ensure noise effects are acceptable. However, as with many constrained urban sites, it is not practical to always comply with these noise limits, even when the best practicable options have been identified and applied to minimise the level and duration of noise emissions. NZS 6803:1999 recommends that a detailed management strategy be applied in these circumstances. A suitable Condition which captures the NZS 6803:1999 management approach has been proposed.

The effect any periods of noise exceeding 70 dB L_{Aeq} may have will depend on a number of factors, including the level of break-in noise experienced inside the receiving building, the internal layout and type of activity undertaken within the receiving building, the duration of the noise emission and at what times it occurs, and the ambient noise levels already experienced in the receiver's location. The effect may also be modified by consultation with the receiver and pre-notification and open communication as the work gets underway.

We have reviewed the constructions of the surrounding buildings and conclude the following with regard to noise effects.

Where construction noise levels incident on the façade of a noise sensitive tenancy such as an office are likely to remain below 75 dB L_{Aeq}, and the duration is relatively limited, we consider that noise effects are likely to be less than minor as day-to-day activities are likely to be possible with minimal disruption.

In cases where construction noise levels are sustained between 76 – 80 dB L_{Aeq} on the façade of a noise sensitive tenancy, we consider this likely to result in a minor noise effect as occupants are likely to need to change their behaviour to respond to higher internal noise levels.

Where construction noise received at the façade of a noise sensitive tenancy exceeds 80 dB L_{Aeq}, this will be disruptive to most kinds of work and communication for the duration of these works. Where works at this level only occur for limited periods of the total construction timeframe (and building life) and neighbours are adequately consulted to devise methods to reduce this effect as far as possible, and given advance warning of key works, this would represent a minor effect, on average.

6.2 Mitigation

The following key physical mitigation measures are proposed:

- Screw piling will be used for the piles located closest to the neighbouring properties.
- The ICE 23RF vibratory hammer, Bosch hydraulic power unit, and the upper rotary parts will be enclosed with Soundex Noise Control Curtain. The hydraulic power unit will be located as far from the boundary as practical.
- The 20 t excavator will not be used within 10 metres of any noise sensitive receiver, where the lower noise 13 t excavator will be used.
- Site hoarding will be installed to screen noise to ground floor tenancies on adjoining sites.

Several other best practice mitigation strategies are discussed in the Ground Works NVMP, including noise monitoring of key pieces of equipment on site. We recommend a NVMP outlining similar strategies is prepared for the remaining phases of construction when a contractor is appointed.

6.3 Predicted levels and likely noise effects

Building E and the buildings on the opposite side of Dowling Street are expected to receive noise levels below 70 dB L_{Aeq} for the majority of activities occurring on the site, due to the distance they are setback from the site and key noise generating activities. This is also the case for the top levels of Buildings D and F with Princes Street frontage, which are located between 21 and 35 metres from the site boundary. At these

locations, there may be an occasional activity which exceeds the construction noise limit of 70 dB L_{Aeq} for brief periods, for example a large excavator scraping near the Dowling Street site boundary, although noise levels at the façade of these buildings are expected to remain below 75 dB L_{Aeq}. For these buildings, we consider that noise effects are likely to be less than minor as day-to-day activities are likely to be possible with minimal disruption.

Many spaces in Buildings B, C, D, F and G have a small setback across Robson Alley. A small excavator scraping, or concrete floating activities may generate noise levels between 76 – 80 dB L_{Aeq} on the closest façades of these buildings for relatively short durations. Sheet piling activity is expected to generate noise levels of 83 dB L_{Aeq} on the facades of these buildings (except Building B) for a period of one to three days. Plate compaction activity close to the boundary may also generate noise levels between 83 dB L_{Aeq} (ground floor) and 87 dB L_{Aeq} (upper levels) for the periods when it is operating close to the boundary. While there are some works at these buildings which are likely to be disruptive to work and communication, requiring occupants to change their behaviour, these are only expected to occur for relatively short durations. We consider this likely to result in a minor noise effect at these buildings.

Building A is located against the boundary of this site and there are several activities which are expected to generate very high noise levels above 80 dB L_{Aeq} at building facades, some at 90 dB L_{Aeq} or more. Noise from works at these levels will be disruptive in the closest tenancies of Building A when they occur. Some of these activities, such as compaction, power floating and site scraping are likely to be relatively transient and won't be maintained at the predicted noise levels at any one tenancy for long periods of time. Since the cumulative number of days when tenancies in this building are likely to receive noise levels above 80 dB L_{Aeq} totals a period of week or more, we recommend tenants within this building are adequately consulted to devise methods to reduce this effect as far as possible and given advance warning of key works. Since works at this level only occur for limited periods of the total construction timeframe (and building life), this will ensure noise effects are only minor, on average.

We consider that the methodology and physical and managerial mitigation described above to represent the best practicable option to minimise noise effects at the nearest receivers. When also considering that ultimately noise from ground works will be of a limited duration, and noting the comment in the Foreword of NZS 6803:1999 that "*construction noise is an inherent part of the progress of society*", we conclude that noise levels due to construction works associated the ACC Development will be acceptable.

Please do not hesitate to contact me if you have any questions.

Kind Regards,

William Reeve
BE Hons (Mech) MASNZ
Senior Acoustic Engineer
Acoustic Engineering Services

Attachment 1 – Photos of nearby buildings

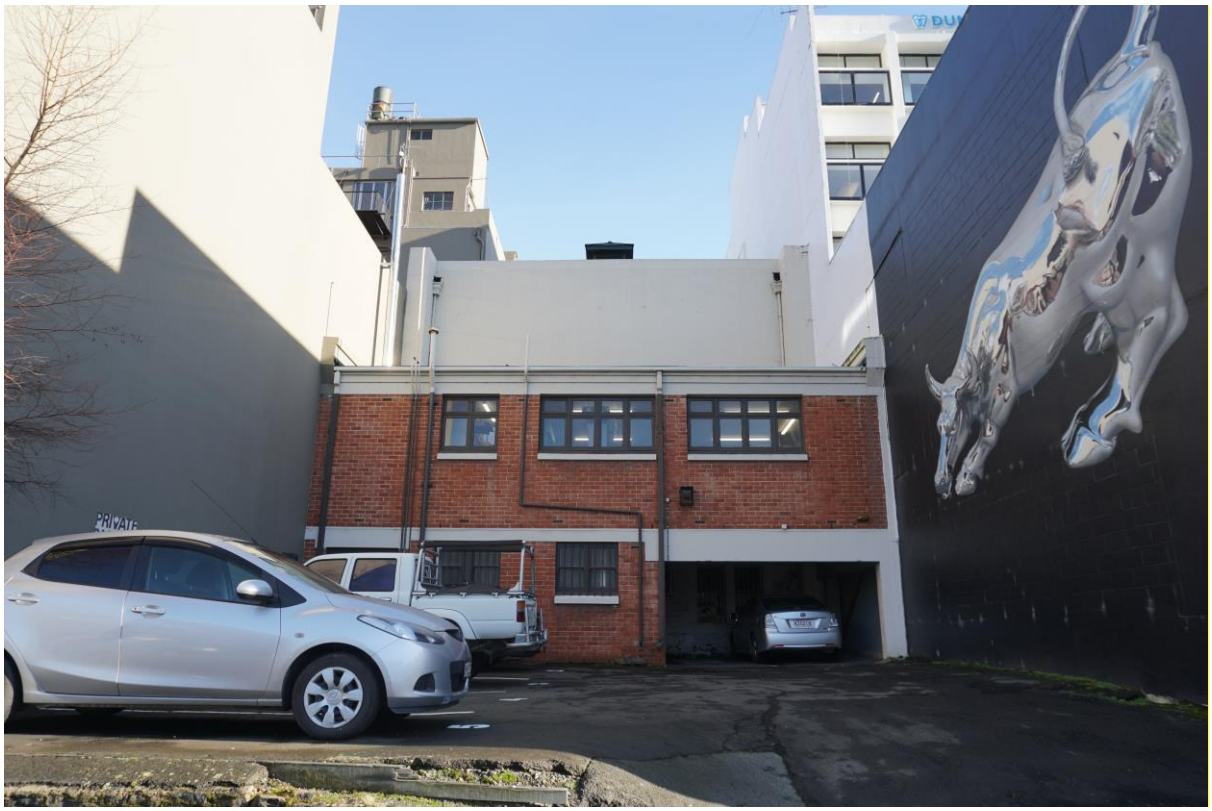
Building A, Harcourts Building, 9 Dowling Street

Building B, 5 Queens Gardens

Building C, Stanton Building, 201 Princes Street

Building D, National Bank of New Zealand Building, 193 Princes Street

Building E, 173 Princes Street



Building F, 169 Princes Street

Building G, 23 Dowling Street

Attachment 2 – Ground Works Noise and Vibration Management Plan

December 2021

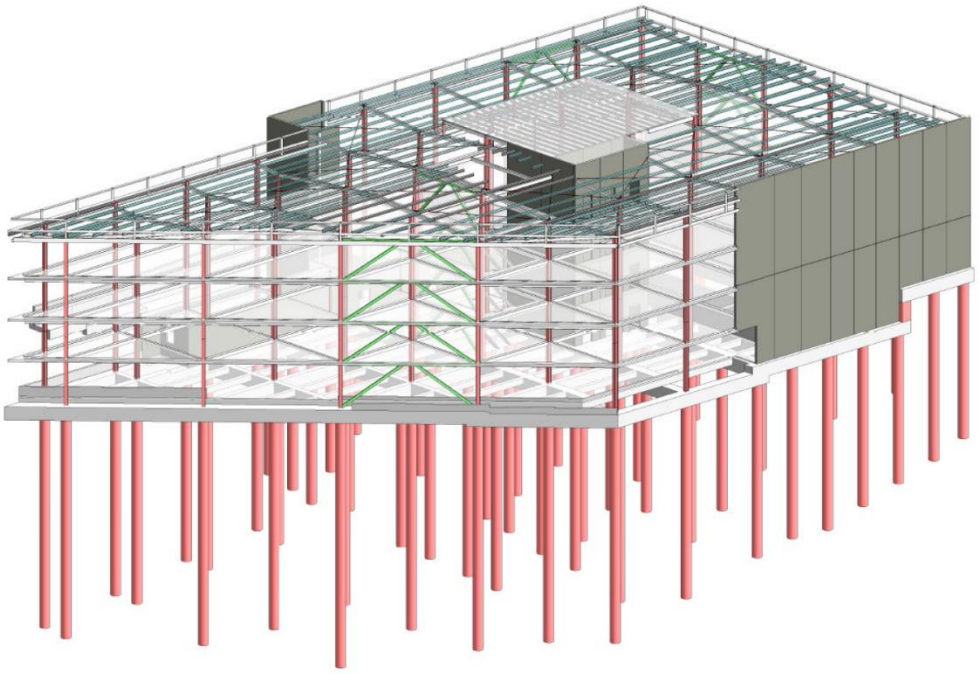
Noise & Vibration Management Plan

ACC Building Dunedin Enabling Works

15 Dowling St, Dunedin Central

Noise & Vibration Management Plan

Report prepared for Smith Crane & Construction Ltd



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Vibration management plan prepared for Southern Geophysical Ltd by:

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SGL Job Reference: 2276
Version 1.4 (Issued Dec 7, 2021)

Internally reviewed by:
M. Finnemore (PhD), Senior Geophysicist

Purpose of Noise and Vibration Management Plan:

This Noise and Vibration Management Plan (NVMP) outlines the measures that will be taken to mitigate noise and vibration nuisance that arises from the work and impacts on other parties. This NVMP outlines the site development process envisaged for this project and the effects of that process on neighbours and the environment in general.

Noise

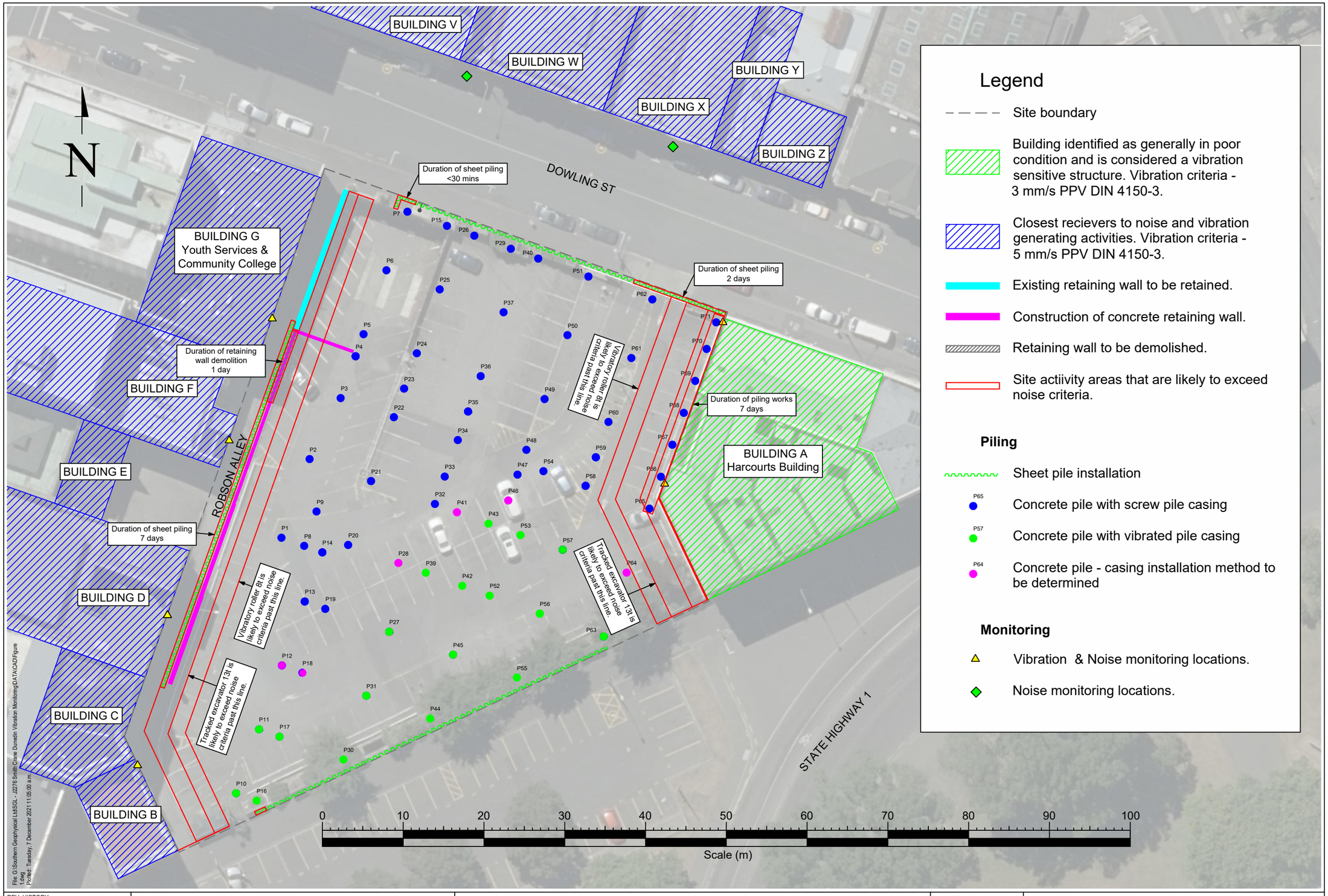
The methodology referred to in the plan has been developed to mitigate the high noise impacts usually associated with construction sites. It has been developed in collaboration with Smith Crane & Construction Ltd. The typical noise limit on a long-term construction site is 70 dB during standard construction hours. The construction methodology proposed for this project is expected to comply with that limit except for several noisy activities that are within close proximity to neighbouring properties (Figure 1). As with any large construction project the NVMP is an iterative process and may require some site and equipment specific solutions.

Vibration

The construction methodology for this site is designed to produce the lowest possible ground vibration disturbance. Construction vibration monitoring will use the German Standard DIN 4150-3:2016[1] as there is currently no New Zealand vibration monitoring standard.

Site Location

The site is located at 15, 15A and 15B Dowling St, Dunedin Central (Figure 1). Access to the site is from Dowling St to the north. The existing site is utilised as a carparking area with retaining structures and planter boxes.



Legend

- Site boundary
- Building identified as generally in poor condition and is considered a vibration sensitive structure. Vibration criteria - 3 mm/s PPV DIN 4150-3.
- Closest recievers to noise and vibration generating activities. Vibration criteria - 5 mm/s PPV DIN 4150-3.
- Existing retaining wall to be retained.
- Construction of concrete retaining wall.
- Retaining wall to be demolished.
- Site actiivity areas that are likely to exceed noise criteria.

Piling

- Sheet pile installation
- Concrete pile with screw pile casing
- Concrete pile with vibrated pile casing
- Concrete pile - casing installation method to be determined

Monitoring

- Vibration & Noise monitoring locations.
- Noise monitoring locations.

REV. HISTORY			
DRAWN BY	TG	DATE	25-11-2021
CHECKED BY	XX	DATE	25-11-2021

15 Dowling St, Dunedin
Noise and vibration management plan details.

FIGURE 1

Southern Geophysical
www.southerngeophysical.com

Scope of Works

The proposed development at this site is for a multi-storey office building. There are several phases of site activity for this project including demolition, archaeological excavation, bulk earthworks, and construction activity.

- Demolition of the site will involve the removal of existing retaining structures using a 20T excavator. The existing carpark pavements will be removed by scraping the surface of the site.
- Temporary sheet pile retaining structures will be installed next to Robson Alley, Dowling St and on the southern site boundary (Figure 1). The vibratory hammer used to install the sheet piles will be suspended with a 100T crawler crane and driven by a Bosch hydraulic power unit.
- Bulk excavation will involve the use of a 20T excavator. The site will be excavated to different levels or heights and will include the construction of fill batters and ramp access for heavy machinery. These works will be undertaken by a 20T excavator. The site will be over excavated by 300 mm with the removed material replaced with a compacted engineering fill to be used as a platform for piling operations. Materials will be disposed of into a truck and trailer and removed from site. Compaction will involve the use of an 8T vibratory roller or 500kg plate compactor.
- Archaeological investigations will be ongoing with areas of the site surface scraped (100 mm per scrape) during general excavation activities.
- Piling works will involve the installation of 71 concrete reinforced piles. Temporary pile casings will be installed using two methods: screw pile casing and vibrated casing. Excavation of the piles will be undertaken with a drilling auger mounted on the piling Bauer BG25 Drilling Rig. If large boulders or obstructions are encountered when excavating, a crane suspended hydraulic clamshell will be used. Prefabricated pile reinforcing cages will be lowered into the pile casing. The pile casing will then be filled with concrete using a concrete pump and tremie tube setup. The temporary pile casings are removed using a vibratory hammer as pile is filled with concrete. Excess water used during the pile concreting process will be pumped into settlement tanks.
- Concrete retaining structures will be installed close to the temporary sheet pile retaining walls. This will involve concrete pouring of new floor slabs and drains prior to the installation of precast concrete wall panels. The concrete panels will be backfilled with aggregate and compacted in layers of 250 mm or less, preferably with vibratory roller. After the concrete retaining walls are installed the temporary sheet piles will be removed with the vibratory hammer.

Duration of Works

Table 1: Duration of key activities.

Activity	Duration
Earthworks	10 weeks
Sheet piling	3.5 weeks
Concrete pile installation	13 weeks

Working Hours

All noise and vibration generating activities associated with this NVMP will only be carried out during the times detailed in Table 2. Quieter activities may occur outside these times including meetings or arranging tools.

Table 2: Site working hours.

Day	Time
Monday – Sunday	07.30 – 18:00
Public Holidays	No work permitted

Noise Criteria

The construction noise levels will be monitored in accordance with the New Zealand Standard for Acoustics - Construction Noise 6803:1999[4], and acceptable noise levels will follow the criteria for long-term duration (> 14 days) work for residential zones. All occupied buildings will comply with the noise limits in the following table.

Table 3: Noise criteria for all occupied buildings.

Day	Time	L_{Aeq} (dB)	L_{Amax} (dB)
Mondays to Saturdays	07:30 – 18:00	70	85
Sundays	07:30 – 18:00	55	85
Public Holidays	No work permitted	-	-

There are several noisy site activities that have been identified as likely to exceed the noise criteria in Table 3. These noisy activities have been highlighted in Figure 1 using the setback values in Table 7. The noisy activities include (Table 4):

Table 4: Noisy activities likely to exceed noise criteria.

Activity	Duration	Receivers
Sheet piling on Robson Alley	7 days	Buildings C-G
Sheet piling on Dowling St (west end)	<30 mins	Building G
Sheet piling on Dowling St (east end)	2 days	Building A
Pile installation adjacent to Building A	7 days	Building A
Demolition of the existing retaining wall adjacent to Robson Alley	1 day	Buildings F-G
Vibratory roller compaction and excavation adjacent to Robson Alley	TBC	Buildings B-G
Vibratory roller compaction and excavation adjacent to Building A	TBC	Building A

Vibration Criteria

The site will be monitored for excessive vibrations arising from demolition, earthworks and construction phases of the project. Building damage and human/perception response will be the main issue from the proposed site works.

Table 5: Vibration criteria.

Receiver	Limit
Any occupied buildings sensitive to noise	*5 mm/s PPV
All other buildings	In accordance with the German DIN 4150-3:2016[1] standard

**Occupied buildings sensitive to noise will follow the vibration limits for residential structures in accordance with the German DIN 4150-3:2016[1] standard.*

Neighbouring Properties

The closest neighbouring properties listed in Table 6 are likely to experience the highest levels of noise and ground vibrations generated by demolition, earthworks and construction related activity. The more distant properties would be expected to be within the vibration limits provided the nearest properties are compliant. The reference name for each building has been adopted from the Dilapidation and Verticality Report undertaken by Paterson Pitts Group[2].

The properties listed in following table are zoned as commercial and mixed-use properties under the Proposed 2GP Dunedin District Plan. Whether these buildings are used for residential and/or commercial purposes for some of these properties is unclear. It will be assumed that these properties are occupied by sensitive receivers until the use of the buildings has been determined.

Table 6: Closest receivers to noise and vibration generating activities.

Reference	Address	Distance to nearest site works (m)	Building use
Building A	9 Dowling St & 16 Queens Gardens	0	Harcourts – Commercial
Building B	5 Queens Gardens	5	La Maison – Commercial
Building C	201 Princes St	1.1	Roof top apartment - Residential
Building D	193 Princes St	1.1	Commercial
Building E	179 Princes St	12.8	Commercial
Building F	169 Princes St	1.2	Commercial
Building G	23 Dowling St	1.3	Youth Services & Community College - Commercial
Building V	1-9/30 Dowling St	17.2	Residential and Commercial
Building W	18 & 20 Dowling St	17.2	Commercial
Building X	14 & 16 Dowling St	17.2	Residential and Commercial
Building Y	12 Dowling St	17.2	Commercial
Building Z	10 Dowling St	17.2	Commercial

**The shortest possible distance from the building (measured from 1 m outside the building facade) to the nearest site works.*

Noise Sources

Table 7 details the appropriate setback distances for specific noise generating activities and equipment. The sound levels in this table have been derived from the British Standard BS5228-1:2009[5], relevant machinery specifications and testing undertaken by Smith Crane & Construction Ltd. This table will be updated with noise level data measured on site during the initial first use of noisy equipment (Table 9). Acoustic screens or site hoarding will be used to mitigate construction noise, but any building level above the ground floor will be in direct line of sight to the noise generating activity. The noise reduction factor of 10 dB applies only to ground floor levels.

The British Standard contains few details on vibratory hammers and hydraulic power units to be used at the site. The estimated setback value in Table 7 assumes that the power unit is situated beside the vibratory hammer. The power unit is particularly noisy and will be set back approximately 10-20 metres (situated towards the centre of the site) from the vibratory hammer to reduce noise levels. Further noise testing of the vibratory hammer and power unit will be undertaken prior to delivery to site to confirm compliance with the noise level criteria (Table 3).

The Bauer BG25 piling rig noise levels were determined from relevant machinery specifications. This assumes the maximum noise levels from the engine are applied and is not specific to the activity being undertaken by the piling rig. Piling works will commence centrally on the site to minimise noise disturbance and further noise testing will be undertaken to confirm compliance with the noise level criteria for piles closer to the site boundary (Table 3).

In the event that compliance is not achievable based on results of site sound monitoring with existing mitigation measures for works closer to the site boundary, further engineering controls or alternative methods will be implemented as well as notification and communication with neighbouring properties.

Mitigating methods involving sound rated acoustic enclosures and screens will be tested to determine their effectiveness in reducing sound levels prior to works commencing. Refer Appendix A for acoustic screen specification.

Note the calculated setback distances have been reassessed from earlier versions of this NVMP based on machinery specifications and the BSI Standards Publication: Code of practice for noise and vibration control on construction and open sites[5] to ensure these values are as correct and accurate as possible. Furthermore, additions have been made to include new equipment. This is a LIVE document and will be updated with testing results and further information when available.

Table 7: Estimated noise levels for key site activities.

	Key site activities and equipment	Activity Sound Power (dB LAw)	Activity Mitigation Sound Reduction (dBA)	Required setback (m) based on 70 dB limit with noise mitigation	Required setback (m) based on 70 dB limit with no noise mitigation
1	**Site Scrap and Demolition**				
a	Tracked excavator 20t (site scrape)	104	10.0	8	21
b	Tracked excavator 13t (site scrape)	96	10.0	4	10
c	Tracked excavator 20t (demolition and loading)	105	10.0	9	23
d	Tracked excavator 13t (demolition and loading)	100	10.0	6	14
2	**Temporary Works and Retaining Structures**				
a	ICE 23RF & power unit (sheet piling)	116	18.8	11	63
b	Tracked Crawler Crane 100t (lifting ICE23RF)	93	10.0	3	8
3	**Archaeological & Bulk Excavation**				
a	Tracked excavator 20t (earthworks)	97	10.0	4	11
b	Tracked excavator 13t (earthworks)	95	10.0	4	9
d	Vibratory roller 8t	101	10.0	6	16
e	Plate Compactor - 500kg	106	10.0	10	25
4	**Piling Works**				
a	Truck (Delivery of steel cage)				
	Truck pulling up	98	10.0	5	12
b	Bauer BG25 piling rig (screw piling & augering)	109	18.8	6	33
c	ICE 23RF & power unit (vibro-driven pile casing)	116	18.8	11	63
d	Craneage for piling (lifting casing / steel cage)	93	10.0	3	8
e	Cement mixer truck (discharging)	101	10.0	6	16

Note: *The calculated setback distances have been reassessed from earlier versions of this NVMP based on machinery specifications and the BSI Standards Publication: Code of practice for noise and vibration control on construction and open sites*[5] *to ensure these values are as correct and accurate as possible. Furthermore, additions have been made to include new equipment. This is a LIVE document and will be updated with testing results and further information when available.*

Vibration Sources

The following table lists the activities and the equipment that is likely to generate ground vibrations at the site. It is not practicable to estimate vibration levels for a specific site, but any activity that occurs within few metres of a building will be monitored closely.

Table 8: Major vibration sources.

Activity	Equipment
Sheet piling	ICE23RF Vibratory Hammer
Vibro-driven pile casing	ICE23RF Vibratory Hammer
Screw pile casing	Bauer BG25 piling rig
Augering (all piles)	Bauer BG25 piling rig
Site Scrape	Tracked Excavator 20t
Earthworks	Tracked Excavator 20t
Demolition of Retaining Walls	Tracked Excavator 20t
Compaction of Aggregates	Vibratory Roller 8t / 500kg Plate Compactor

Mitigation

Noise

The key site activities that will involve noisy equipment will use mitigating measures detailed in the following table. All enclosures and acoustic sleeves will use acoustically rated Soundex Noise Control Curtains (refer Appendix A).

Table 9: Mitigation of noisy activities and equipment (information supplied by Smith Crane & Construction).

Activity & Equipment	Mitigation
Sheet piling and concrete pile casing installed with ICE23RF vibratory hammer and Bosch hydraulic power units.	The Bosch power unit will be covered by an acoustic enclosure with one open side that will be rear facing. The vibratory hammer will have an acoustic sleeve that covers the entire hammer and extends to just below the top of the pile. The Bosch hydraulic power unit will be positioned central to the site and at the maximum practicable extension from the hammer.
Screw pile casing and augering with the Bauer BG25 Piling Rig.	The Bauer BG25 will have an acoustic enclosure around the engine with the rear side open. The upper rotary parts that are subject to high noise levels will be enclosed with an acoustic rated sleeve.
Tracked excavators 20t and 13t (earthworks and demolition).	Site hoarding will be erected at the site boundaries. This will mitigate noise for building ground floor levels only. Any level above ground floor will not be protected. The excavator will track slowly as is practicable. When within 10 m of any noise sensitive receiver the 13t excavator will be used.
Vibratory roller 8t and 500kg plate compactor (compaction).	Site hoarding will reduce the noise levels from the compactors for building ground floor levels only. All compactors will be throttled down gently and will track as slowly as is practicable.

The site noise mitigation measures will be based on the NZS 6803:1999[3] guidelines and the experience of Smith Crane & Construction Ltd in noise mitigation at construction sites. To mitigate construction noise levels, the following general measures will be undertaken:

- Where possible, use the quietest machinery and methods available.
- All machinery will be either new, or in good condition upon its arrival at the site and will thereafter be maintained in good condition throughout the entire duration of the project.
- Upon arrival at the site, the machinery and plant will be checked to ensure that it is not generating unnecessary noise and will be rectified if necessary.
- When selecting any compressors, generators, or pumps for use on the project, the degree of noise generation between models will be considered as a major factor.
- All machinery, (including excavators, cranes, and generators) will be fitted with appropriate exhaust silencers where practicable.
- When machinery or plant on site is not required to be running, it should be switched off and not left idling.
- Noisy plant and machinery should be strategically positioned on the site to reduce the effects on neighbours where practicable.
- The tail gates of trucks must be closed with care and not slammed or allowed to fall closed causing unnecessary noise.
- Where appropriate, use acoustic enclosures or noise reduction screens for machinery or noisy work areas.
- Noise caused by friction in rollers, trolleys or other machines can be reduced by proper lubrication.

Vibration

The key site activities that will involve vibration generating equipment will be mitigated as detailed in the following table:

Table 10: Mitigation of vibration generating activities and equipment (information supplied by Smith Crane & Construction).

Activity & Equipment	Mitigation
Sheet piling and concrete pile casing installed with ICE23RF vibratory hammer and Bosch hydraulic power units	The vibratory hammer chosen for this project is varying frequency, resonance free hammer to mitigate disturbance when compared to other vibratory hammers. The frequency of the vibratory hammer impacts will be set high and the speed at which the sheet piling is driven into the ground will be undertaken at a steady pace particularly when near sensitive receivers. Steel casing will be installed in short sections and excavated frequently to reduce the friction on the casing during installation.
Screw pile casing and augering with the Bauer BG25 Piling Rig.	This piling method was selected to minimise noise and vibration to neighbouring properties. Pile rig attachments or tooling will be placed (not dropped) on the ground. The piling rig will be tracked slow across the site to minimise vibrations.
Tracked excavator (earthworks and demolition)	The tracked excavator will track slowly across the site to minimise vibrations. The concrete breakout from demolition of the existing retaining wall should only be broken into smaller sizeable blocks away from sensitive receivers.
Vibratory roller 8t and 500kg plate compactor (compaction)	The temporary sheet piling is an alternative design to minimise the required backfill and compaction close to the boundary. The roller will be used centrally on the site and where required, a plate compactor will be used near the boundary to minimise disturbance. The vibratory roller and plate compactor should be throttled gently. If possible, the frequency of the vibratory roller or plate compactor impacts will be increased.

To mitigate the risk of building damage to the neighbouring properties, the following general measures will be undertaken:

- Where practicable, use machinery and methods that produce the lowest source of vibrations.
- When loading or unloading trucks, care must be taken to ensure materials are not dropped from height.
- When loading trucks, load softer material at the bottom.
- Limit truck movement and speeds onsite and position loading zones away from sensitive structures.
- Heavy machinery attachments or tools must be placed carefully on the ground.
- Heavy machine operators will track the machines as slowly as is practicable (fast tracking across a site can generate high vibration levels).
- Workers will be made aware of the impacts of vibration and the methods that can be used to minimise its generation before works begin on site.

As site response to vibration is poorly known for the site, it is recommended that were possible initial “runs” of vibration and noise equipment are conducted as far as possible from sensitive structures and residential receivers.

Monitoring

Noise

Noise levels at the site will be measured using a calibrated Class 1 sound level meter. Measurements will be undertaken in accordance with NZ 6801:1999[4] and NZ 6803:1999[3] and will be recorded on the survey sheet in Table 11. Noise level measurements will be undertaken at the following times:

- During the first use of any equipment or activity that generates high noise levels.
- Noisy activities or equipment will be sampled at regular intervals (must not exceed two weeks) for the duration of the project to ensure ongoing compliance.
- Within two working days of a noise complaint at the location where the perceived noise levels were experienced during normal use of the noisy equipment or activity.

Table 11: Noise measurement survey sheet.

Date/time	Noise source activity or equipment	Noise receiver location	Noise source to receiver distance (m)	$L_{Aeq(t)}$ (dB)	L_{Amax} (dB)

Noise monitoring will be undertaken during the first use of noisy equipment (Table 9). The noisy equipment will be sampled to characterise the activity noise levels. Noise levels will also be sampled at a minimum of two locations at the commercial storefronts on Dowling St (Buildings V-Z in Figure 1) when noisy equipment is operating within 10 m of northern site boundary. The noise level data will be used to update the setback distances in Table 7 and this will be referred to when positioning or operating noisy equipment onsite.

If noise complaints arise, the activity noise levels will be measured at the perceived location as indicated by the complainant during normal use of the noisy equipment. If the noise levels are in excess of the noise criteria outlined in Table 3, noise mitigation measures will be used to reduce noise levels. The activity noise levels will then be measured again to determine if noise levels are within limits. Noise measurements should be made outside the building approximately 1 m from the wall most exposed to the sound under investigation[3].

Vibration

Two calibrated Texcel ETM vibration monitoring units will be used to measure vibration levels at the site. The vibration monitors will be set to record continuously between the hours of 6:30 – 19:00 with background vibration levels measured every minute. In addition to the continuous measurements, any vibration event with a Peak Particle Velocity (PPV) of 0.3 mm/s or greater will be recorded. The vibration monitoring units will be set to automatically notify (via SMS or email) the site manager for any vibration event within 80% of the vibration criteria. Vibration measurements will be in accordance with the following table.

Table 12: Vibration guidelines from DIN 4150-3:2016[1] for assessing effects of vibrations on buildings.

Type of structure	Vibration thresholds for building damage, PPV (mm/s)				
	Short term				Long term
	At foundation			Uppermost floor	Uppermost floor
	0 to 10 Hz	10 to 50 Hz	50 to 100 Hz*	All frequencies	All frequencies
Commercial/industrial	20	20 to 40	40 to 50	40	10
Residential	5	5 to 15	15 to 20	15	5
Sensitive/historic	3	3 to 8	8 to 10	8	2.5
**For frequencies greater than 100Hz, the maximum vibration velocity specified in this column is applied.*					

The Harcourts Building (Building A in Figure 1) is within close proximity to the site and is likely to be susceptible to vibration related activity. A vibration monitor will normally be positioned centrally on the west side of the building (Figure 1) to measure ground-borne vibrations from the surrounding site. This monitor will be moved to the north-west corner of building during sheet piling operations along Dowling St. The vibration threshold for this building will be set at a Peak Particle Velocity (PPV) limit of 3 mm/s in accordance with the German Standard DIN 4150-3:2016[1] for sensitive structures (Table 12).

A second 'roving' vibration monitor will be used to measure vibrations at the buildings (Buildings B-G) on the west side of the site (Figure 1). The vibration threshold for these buildings will be set at a PPV limit of 5 mm/s in accordance with the German Standard DIN 4150-3:2016[1] for residential structures (Table 12). This vibration monitor will be positioned at the closest mounting point (Figure 1) to the site activity or equipment generating the highest vibration levels. It will be the requirement of the Smith Crane & Construction Ltd site manager to move the vibration monitor accordingly. Southern Geophysical Ltd will be notified when the vibration monitor has been moved and a site photograph supplied. This vibration monitor may be temporarily used to investigate any complaints related to vibration activity.

The vibration monitoring units will be set to automatically notify (via SMS or email) the site manager if vibrations levels are within 80% of the vibration criteria outlined in Table 5. Vibration measurements are continuously recorded during the site working hours (Table 2) and all data is remotely downloaded to the Southern Geophysical Ltd office in Christchurch.

If vibration levels do exceed the recommended levels, the activity or equipment generating the excessive vibrations will cease. Smith Crane and Construction Ltd may in the first instance use measures to mitigate the vibrations. This may involve simple changes including changing the type of equipment, how the equipment is used or by increasing the distance between the vibration source and the building being monitored. If there is no practicable way to reduce the vibration levels, Smith Crane and Construction Ltd will in consultation with the Dunedin City Council undertake a review of the earthworks or construction methodology before work can continue.

Building Condition Survey

A building condition survey was undertaken on Building A (Harcourts Building) by surveying firm Paterson Pitts Group[2]. The survey identified two rooms extending from the main building that are in poor condition with concrete cracking on the floors and iron roofs that are in a state of disrepair. In general, the external brick walls exhibit cracks, spalling, mortar repairs and slight variations in wall verticality. The existing building fabric appears to be in an overall poor condition. The observed degradation establishes a baseline for determining whether construction vibrations are having an effect on the structure. Daily visual inspections of the Harcourts Building will be undertaken by Smith Crane & Construction Ltd.

Site Supervision

The site will always be supervised by a competent site supervisor trained and experienced in earthworks or construction site management. At all times during working hours a site supervisor or delegated stand-in site supervisor will be present on the site and be competent to deal with project site issues.

Site Operatives Training

Training and proof of competency records will be held on site for all machine operators. All other site operatives will be required to hold a Site Safe Passport or alternative Safety Training Record. This may be an in-house training record.

Reporting and Communication

Reporting

Southern Geophysical Ltd will provide a weekly vibration monitor report to Smith Crane & Construction Ltd. Note that vibration levels are actively monitored during the site development process with automatic notifications (via SMS or email) sent to the site manager if the vibration levels are within 80% of the vibration criteria. Text notifications can be provided to machine operators where necessary.

Communication with Neighbours:

The residential and commercial premises operating adjacent to the construction site will be advised of any noise or vibration generating activities for the duration of these works. It is important to note that even low levels of vibration may be experienced by adjacent properties but not necessarily be of an amplitude and frequency to cause damage to their building.

Good communication with neighbours can dramatically reduce noise and vibration complaints. Scheduling the use of equipment at times when buildings are unoccupied or when the occupants are less sensitive to noise and vibrations can alleviate complaints. This will need to be determined by discussion with the affected neighbours.

Complaints Procedure

If noise or vibration complaints arise, Smith Crane and Construction Ltd will sample the noise or vibration source at the location where the perceived vibrations appear excessive. This will be undertaken within two working days of receiving the complaint. The complaint will be assessed, acted upon, and closed out within one week.

The complaints process involving the Smith Crane & Construction Ltd, project manager and site manager will be implemented as follows:

- All complaints will be directed in the first instance to the Smith Crane & Construction Ltd designated site manager.
- This person will have responsibility to ensure that the complaints procedure is enacted.
- The site will have prominently displayed the works signboard with the 24-hour contact number of the site manager.
- The site manager will maintain an onsite complaint register and log of actions taken.

  The register will include:

  a. A standard complaint form.
  b. Date of complaint.
  c. Complainant name.
  d. Actions taken.
  e. Report back to complainant.
  f. Close out.

- The management of complaints during the delivery phase will receive high level attention from the Smith Crane & Construction Ltd project/site management.
- Ensuring that complaints are noted, acted upon, and closed out will be a Key Performance Indicator adjudging the successful completion of these works.

References:

[1] Deutsches Institut fur Normung. Vibrations in buildings – Part 3: Effects on structures. English translation of DIN 4150-3:2016.

[2] Paterson Pitts Group. D17873 Dilapidation and Verticality Report. July 2021.

[3] New Zealand Standard. Acoustics – Construction Noise. NZS 6803:1999

[4] New Zealand Standard. Acoustics – Measurement of environmental sound. NZS 6801:1999.

[5] BSI Standards Publication. Code of practice for noise and vibration control on construction sites – Part 1: Noise. BS5228-1:2009.

Appendix A: Acoustic Screen Specification

SOUNDEX®

Soundex Curtain

Soundex Curtain

This BS EN 32.9 dB rated curtain has become the preferred choice of many contractors, boasting almost unrivaled attenuation and noise absorption.

Designed specifically to provide high-absorption acoustic screening around site plant and other high noise emitting activities, its unique Velcro fastening ensures a seamless noise barrier with eyelets on all edges to enable easy suspension. The fold-and-lay-flat design enables easy storage and transportation.

Features & Benefits

- Up to 32.9dB reduction in noise
- Tested and certified to be hung from scaffolding BS57955
- Fire resistant and weatherproof
- Non-irritant acoustic material with no glass-fibre
- Velcro connections to ensure optimum performance

Key Applications

- Ideal for creating temporary enclosures for piling rigs, or compressors and generators
- Suspended off scaffold façades during demolition
- Suspended off temporary fencing during street utility works
- Suspended off fencing surrounding generators
- Lining internal party walls and hoarding

Product Testing and Certification

- Laboratory Acoustic Test BS EN ISO 10140-2-2010 & BS EN ISO 717-1:2003
- Laboratory Absorption Test BS EN ISO 354:2003 & BS EN ISO 11654-1997
- PVC Containment Sheets BS 7955:1999 Clause 4.3: tensile Strength, Clause 4.4: Attachment Point Strength, Related Specification: BS 2576:1996.
- Bureau Veritas Fire Test BS 476 Part 12 1991
- Bureau Veritas Field Test to BS 5821:1984
- Exova/BTTG Fire Test BS 7837:1995 (2015)
- DMA Curtain Wind Load Calculations BS 5975

SOUNDEX®

Soundex Curtain

Technical data							
Size	1250 x 2050mm						
Weight	11.7kg each						
Maximum Sound Absorption	46% @ 250Hz 94% @ 1000Hz 98% @ 5000Hz						
Maximum Sound Attenuation	18.8 dB @ 250Hz 22.9 dB @ 1000Hz 32.9 dB @ 5000Hz						
Test data at various Hz. (Product Testing and Certification BS EN ISO 717-1 : 1997;BS EN ISO 345 : 2003; EN ISO 11654 : 1997)							
Hz.	250	500	1250	2500	4000	5000	Rw Value
Reduction dB	18.8	22.8	22.5	27.5	31.1	32.9	24
Absorption αs	0.46	0.70	0.96	0.83	1.00	0.98	0.70
Fire ratings							
Acoustic Vinyl Membrane	M2 / B1 / BS / B-s2-d0 / NFPA701						
Acoustic Core	Class 0						
Acoustic Mesh Membrane	M2						
Printing	Water Based Ink						

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www.rvtgroup.co.uk

RVTGROUP™
Protecting long-term health on site

Appendix C

Site Plans and Noise Recievers

Scale: 1:500@A3

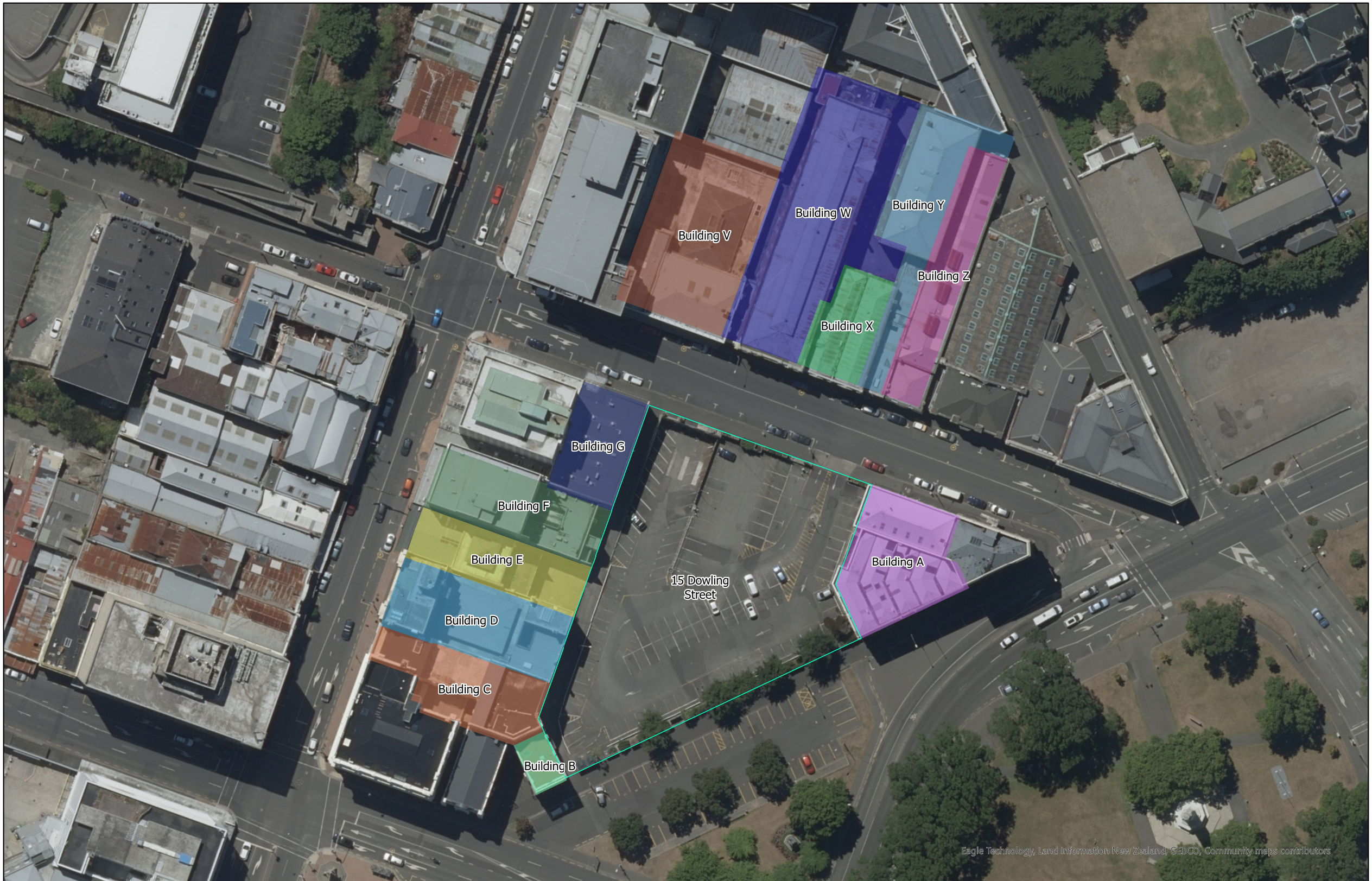
0 10 20 Meters

Construction Noise Resource Consent
Dowling Street Construction Activities

Date: 24/02/2022
Version: 1.0
Drawn: JN

N

4SIGHT CONSULTING



Scale: 1:750@A3

0 20 40 Meters

Construction Noise Resource Consent
Adjoining Buildings

Date: 1/03/2022
Version: 1.0
Drawn: JN

N

4SIGHT CONSULTING

NOTE: Floor layout is indicative only and is not based on any measurements.

15 Dowling Street
ACC Ōtepoti site

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E dunedin@ppgroup.co.nz

Client/Location:
RCP Limited
9 Dowling St & 16 Queens Gardens
RT OT18C/1247

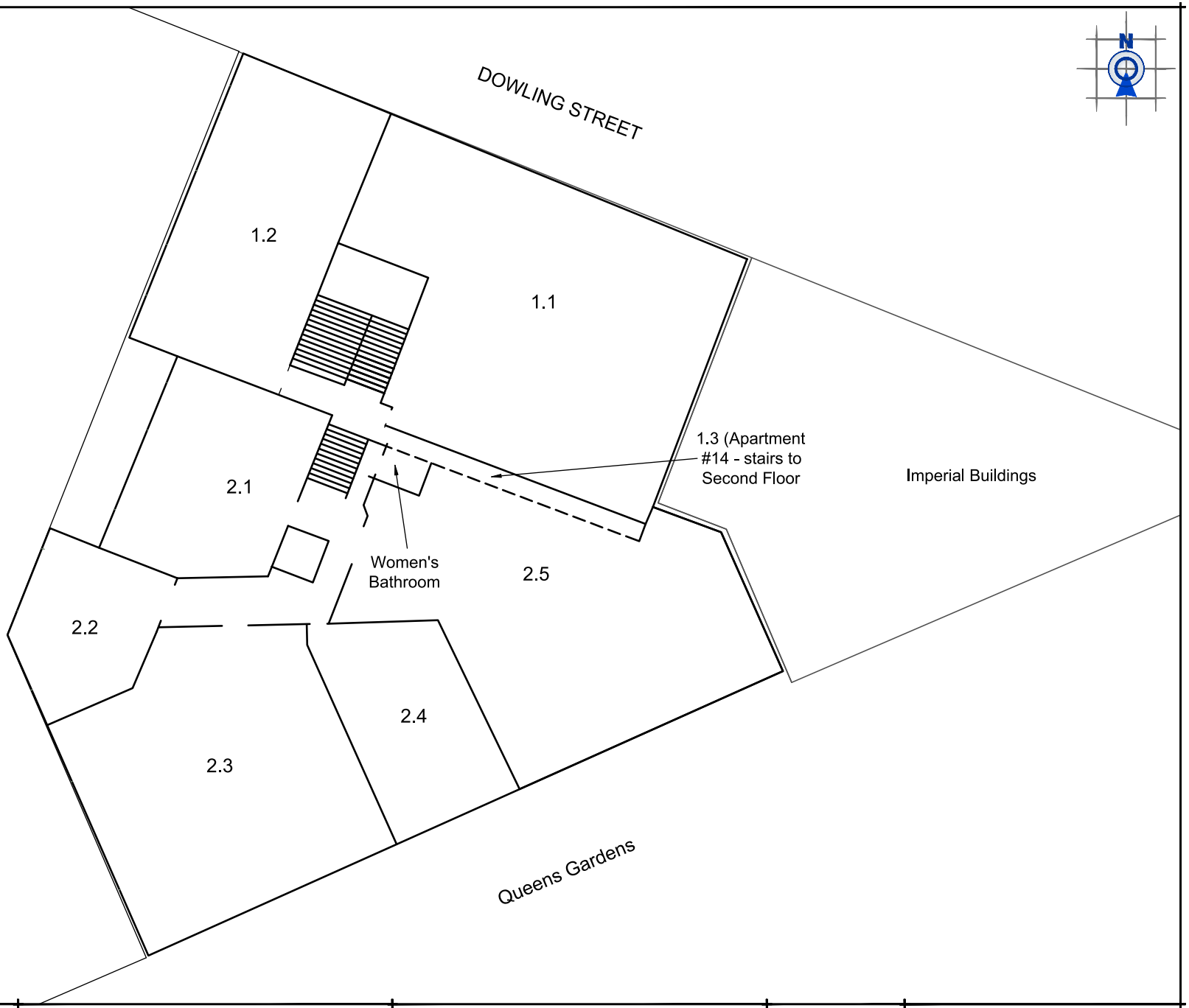
Purpose/Drawing Title:
Cromwell Chambers
Indicative Floor Plan
Ground Floor

Surveyed by:	DNS	Original Size:	Scale:
Designed by:		A3	1:150
Drawn by:	DNS		DO NOT SCALE
Checked by:	DNS		
Approved by:	KAB		
Job Ref: D17873		Sheet No: 01	Revision No: -
			Date Created: 25/11/2021

PLOT DATE: 25 November, 2021 - 7:58 PM BY: David Shearer

NOTE: Floor layout is indicative only and is not based on any measurements.

15 Dowling Street
ACC Ōtepoti site



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Client/Location:
RCP Limited
9 Dowling St & 16 Queens Gardens
RT OT18C/1247

Purpose/Drawing Title:
Cromwell Chambers
Indicative Floor Plan
First & Second Floors

Surveyed by:	DNS	Original Size:	Scale:
Designed by:		A3	N.T.S.
Drawn by:	DNS		DO NOT SCALE
Checked by:	DNS		
Approved by:	KAB		
Job Ref: D17873		Sheet No: 03	Revision No: -
			Date Created: 25/11/2021

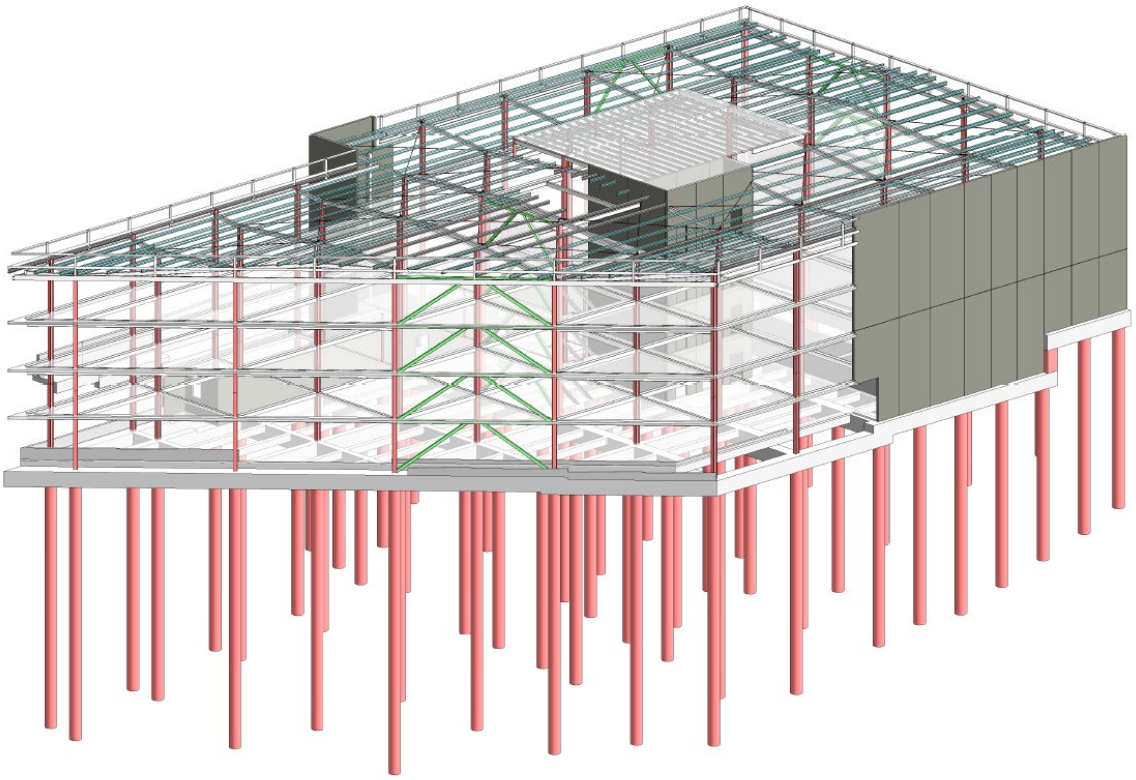
PLOT DATE: 25 November, 2021 - 7:58 PM BY: David Shearer

Appendix D

Construction Management Plan by Smith Crane and Construction

NGĀI TAHU Holdings

SMITH CRANE & CONSTRUCTION



ACC DUNEDIN ENABLING WORKS CONSTRUCTION MANAGEMENT PLAN

DOC#: 50305-09-01 REV. H
DATE: 10/02/2022

Distribution	Copy	Rev	Date
SCC Head Office - Christchurch	1	H	10th February 2022
SCC Site Office - Dunedin	2		
Ngāi Tahu Property - Christchurch	3	H	10th February 2022
Document Number: 50305-09-01 Rev. H			

Table of Contents

1. Project Introduction and CMP Objectives

1.1. Project Introduction

This Construction Management Plan (CMP) covers the proposed construction sequence, methodologies and controls for ACC Dunedin Enabling Works.

The site is located in Central Dunedin, access via 15 Dowling Street, which is a single lane carriageway road. The site is bordered by Robson Alley, an access road for neighbouring properties through to SH1. Located on this site is to be multi-level office building. The existing site is a carpark with retaining structures and planter boxes. The enabling works package consists of site scrape and demolition of existing structures, archaeological excavation, bulk earthworks, retaining wall construction and piling works. The new building is to be constructed on 71 reinforced concrete cylindrical piles

1.2. CMP Objectives

This construction management plan will focus on the excavation, piling foundation and retaining structure aspects of the construction works for this project. With reference to Otago Regional Council (ORC) Resource Consent No. RM21.364.01 LAND USE CONSENT, Consent No. RM21.364.02 DISCHARGE PERMIT and Dunedin City Council (DCC) LUC-2021-158 the objectives of the CMP are to:

- Outline a construction methodology
- Demonstrate management procedures to deal with the potential adverse effects of construction activity on the environment
- Outline how construction activities are to be managed to mitigate erosion, dust and sedimentation
- Demonstrate how contaminated material will be managed during excavation
- Demonstrate how archaeological findings will be managed during excavation
- Demonstrate how construction activities shall be managed to minimise noise and vibration
- Demonstrate how construction activities will be managed to provide a secure site from a health and safety perspective. Including measures to maintain a safe pedestrian and transport network.

- Demonstrate management procedures toward public interface and safety of public, and other parties affected by construction works such as neighbouring buildings and other contractors.

1.3. Construction Contract Conditions

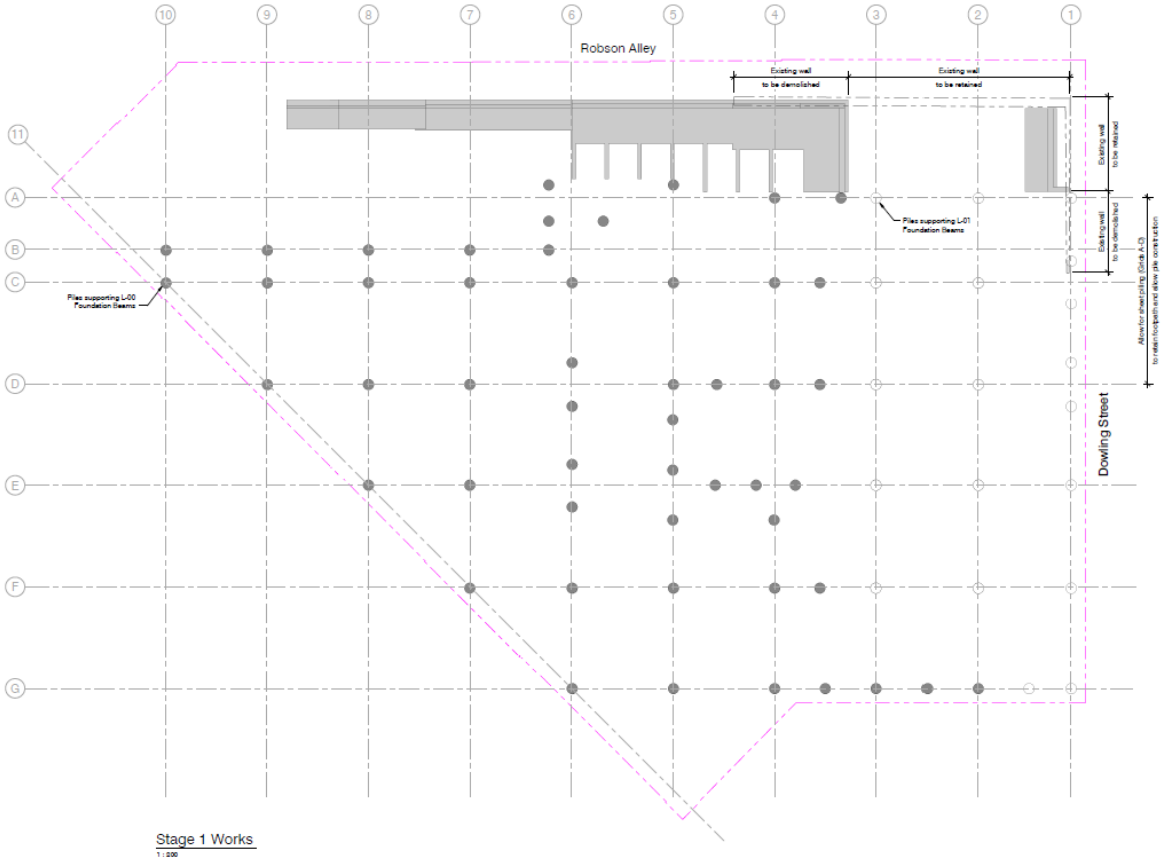
The contract between Ngāi Tahu and Smith Crane and Construction requires submission and approval of a CMP prior to commencement of works. Provision of this CMP fulfils compliance with this requirement and consent condition LUC-2021-158 14 and compliance with the CMP fulfils consent condition 15. The CMP may be reviewed and amended as required to achieve the outcomes of this consent, with any amended plan to be submitted to the Council.

The consent holder must implement the CMP certified by the Council under ORC Consent RM21.364.01 LAND USE CONSENT and RM21.364.02 DISCHARGE PERMIT, and DCC Consent LUC-2021-158 for the duration of the construction activity occurring on the site, and a copy must be maintained on site.

2. Scope of Works

The enabling works construction phase of the project incorporates new 4m – 24m deep reinforced concrete bored piles. Additionally the works involve masonry and reinforced concrete retaining walls. It is estimated that this construction phase of the project will be 5 Months.

1. Site Establishment
2. Mobilisation of equipment to site
3. Site scrape and demolition
4. Temporary works and retaining structures
5. Archaeological excavation
6. Bulk excavation, with handling and disposal of contaminated material
7. 71no. 4-24m deep temporary cased reinforced concrete bored piles
8. New reinforced concrete & masonry retaining walls along Robson Alley and Dowling Street
9. Demobilisation from site.



3. Methodology

3.1. Contract Documentation

Prior to mobilisation, SCC will prepare and submit a site specific safety plan (SSSP), construction environmental management plan (CEMP) and quality control plan (QCP) for review and approval. A JSEA, SWMS and site risk register will be prepared and submitted for review to be distributed to SCC on and off site, the principal and other parties involved. These will define the methodology and identify the safety, quality and environmental hazards and controls relevant to the project. Furthermore, a detailed programme and other required work plans and documentation will be submitted for review.

3.2. Health & Safety Systems and Procedures

Ensuring the safety of the project team and the public is Smith Crane and Construction's number one priority. Predicting and resolving challenges before they arise through experience and appropriately trained and educated personnel is the key to safe and successful project delivery.

Smith Crane and Construction operates a risk-based safety management system, where risks are proactively identified and managed to ensure a safe working environment. Central to this is the company's Health Safety and Wellbeing Plan and Policy, together with the Site Specific Health and Safety Plans that are created at the outset of every project outlining the project risks, PPE requirements, construction methodology, evacuation procedures, nearest hospital and compliance with all relevant safety legislation and standards. The Site Specific Safety Health and Safety Plan includes reporting timeframes, procedures and contact details for reporting, and is reviewed regularly throughout the course of the project.

Safe Work Method Statements are prepared prior to each work activity to identify and manage key risks. All team members are involved in the development of Safe Work Method Statements to ensure they are actively engaged in assessing risk, determining the appropriated safety requirements and controls, and have a full understanding of the required work. Smith Crane and Construction also encourages clients to participate in Safe Work Method Statement development to ensure all viewpoints are considered and captured.

3.3. Traffic Management Plan

A Traffic Management Plan (TMP) will be prepared for the enabling works (Refer Appendix D). Oversized loads will arrive between 6.30am and 7.30 am. An STMS will be on site prior to 6.30am to manage oversized loads as they arrive. Refer TMP for site access.

3.4. Site Security

Initially, the site will be temporarily fenced prior to commencement to the full street frontage with hazard boards erected. Once the temporary works and demolition has been completed the site will then be hoarded for the duration of the works. A gate will be on the Dowling Street access to control movements in and out of the site.

3.5. Site Establishment

Refer Section 4 for site layout. Upon site handover, a 20T Excavator will be transported to site to commence site scrape. Site facilities including a 20ft site office, 20ft break room, and 20ft tool container will be mobilised to site. Sanitary facilities, water and power will be implemented. Waste bins will be located on the site to store all waste and replaced/ emptied as required A services survey will be undertaken to locate, relocate and protect existing underground services. Plant and equipment will be mobilised from SCC's headquarters in Christchurch one week prior to commencement of piling works. Plant and equipment to construct the piles includes SCC's Bauer BG25 Drilling Rig, Vibratory Hammer, 100T crawler crane, 20T Excavator and settlement tanks. During any piling works, vibration monitors will be installed on adjacent buildings to the work area. The vibration monitoring will be as per the Noise & Vibration monitoring plan, refer Appendix C. Level survey will be undertaken to set excavation heights and set out of site. Ongoing survey and set out will be performed throughout piling progress. Piles will be surveyed for as-built location upon completion.

3.6. Site scrape

Once the site has been established, demolition of the existing structures will commence with 20T Excavator as well as a site scrape of existing pavement. All earthworks, handling and disposal will be in consideration with the Contaminated Land Site Management Plan (CLSMP) and Asbestos Removal Control Plan (ARCP).

3.7. Archaeological Excavation

An archaeological survey has been performed on the site prior to piling works commencing. The site is subject to an Archaeological Management Plan (AMP) with areas of the site subject to 100mm scrapes during excavation and all areas subject to archaeological supervision during excavation. During site works, should any items of interest be discovered, work shall stop immediately in that area and Heritage Properties be notified immediately and AMP protocols will be followed. Refer to Section 7. and Appendix B in this CMP. The first portion of works required due to consent conditions is to perform archaeological investigations and excavations over the whole site. This will start in Stage 2 followed by Stage 1, Stage 3 then Stage 4.

3.8. Consent Staging

Due to consent conditions, the project works will be performed in up to three overarching stages. Stage 1 will be works that comply within the noise limits detailed in the 2GP and consent conditions. Stages 2 and 3 will be works that are predicted to exceed the construction noise standards within the 2GP for which a separate resource consent will be sought. Following Archaeological Excavations, Stage 1 works will be undertaken first until works for Stages 2 and 3 are consented and the full site works have been released. Then the sub-stages detailed in Section 3.10 of this report and the second staging plan will govern staging of works. Stages will be identified by ground marks or pegs on site to ensure that current works are located within the established boundaries within the consent stages.

3.9. Temporary works and sheet piling

Temporary retaining structures will be installed prior to bulk excavation and demolition of the existing retaining structures. The temporary retaining structures will be in the form of sheet pile walls. The sheet pile walls will limit the amount of excavations required on Robson Alley and Dowling Street boundaries. Sheet piles will be installed with Crane suspended Vibro Hammer.

3.10. Bulk Excavation

Bulk Excavation will be performed in compliance with the requirements detailed in the CLSMP, ARCP and AMP. The whole site will be subject to supervision of Heritage NZ with compliance to the AMP and accidental discovery protocol. The excavation will be performed in stages as per the following staging sequence. Stage 1 will be excavated to the bottom of the ACM or to site level, whichever comes first. Areas with exposed ACM for extended periods of time such as required batters will be covered with filter fabric. Following an asbestos clearance certificate, Stage 1 will be excavated to site level, Stage 1.1 has been deemed an ‘area of interest’ and will be under supervision of Heritage NZ and performed in 100mm scrapes in conjunction with the ARCP. Following Stage 1, stage 2 will be performed in 100mm Scrapes with compliance and supervision of Heritage NZ AMP. Stage 3 will then be performed as bulk excavation. Finally, Stage 4&5 will be excavated to site level with compliance to ARCP. Stage 4 will be excavated to site level, if the ACM is deeper than excavation levels, localised asbestos removal and remedial will be performed at pile locations and then backfilled with clean fill. As stage 4 is excavated, the exposed excavation will be covered by a 300mm piling platform of clean fill, this will minimise exposed soils for extended periods of time. The interface between level 1 and level 0 will be battered with an extension to level 1 to allow for access for the piling rig at the top of the level 1 cut (Grid line 3). This batter will be cut back once these piles are complete and cured. A ramp will be installed in front of the Dowling Street access between Grid lines E and F to allow for machinery and trucks to move between levels. Excavation will be undertaken with a 20T excavator and material will be disposed of in Truck and Trailer as practical or Truck only. Asbestos contaminated material will be loaded into lined hook bins and covered and disposed of at the approved facility. Areas of contamination and interest to Heritage NZ will be delineated to ensure that the appropriate measures are undertaken when working in these areas. The site will be over excavated by 300mm to be replaced with a working/piling platform. This will be constructed of 300mm thick imported engineered fill and compacted to allow for heavy machinery such as 100T Crawler Crane and BG25 Piling rig have a suitable platform to operate on.

Excavation Staging as follows:
Stage 1 Asbestos remediation – followed by Class B Clearance Certificate – then bulk excavation treated as Heavy Metal contamination
Stage 1.1 As Stage 1 but in cooperation with heritage NZ
Stage 2 Heritage Excavation treated as Heavy metal contamination
Stage 2.1 As Stage 2 but with asbestos removal to site level with localised pile location remedial
Stage 3 Bulk Excavation treated as Heavy metal contamination
Stage 4&5 Asbestos removal to site level with localised pile location remedial

3.11. Piling Works

Piling will commence in Stage 1 as this will be the first stage of the site that is available following the earthworks. Piling will follow the excavation stages one through four as they come available. Refer Section 5 for Staging and Construction Programme. All excavation of piling cases will be performed under super vision of Heritage NZ with compliance to the AMP and accidental discovery protocol. Excavations will be also be in accordance with the ARCP as required.

This project requires large casings to be installed in a densely populated area, in close proximity to neighbouring properties. SCC will install the piles up to 17m deep with temporary sectional screwed casing with our rotary piling rig to minimise vibrations, noise and disturbance to the surrounding environment. The piles over 17m in length will be installed with our high frequency low vibration ICE23RF Vibratory hammer in two casing sections. Pile Casings will be in 12m lengths and splice welded on site.

Piles will be excavated with a drilling auger mounted on the piling rig, however, if unsuccessful due to large boulders or obstructions, a purpose built hydraulic clamshell suspended from the crane will be used. Pile reinforcing cages will be delivered to site pre-fabricated as required to minimise congestion and labour on site. Reinforcing will be pitched and lowered into place with the 50T Crawler Crane with heavy duty pile spacers and chairs to ensure concrete cover during construction. Special care will be taken to ensure pile reinforcing is aligned correctly such that it does not obstruct ground beam reinforcing and adjustments can be made to the starter bars and nuts if required. Piles with a deep cut off will be lagged with foam tubing to allow for protection to the bars and assist with concrete break out.

Piles will be poured in the morning; a concrete pump will be used to inject concrete through a tremmie pipe to ensure segregation of the aggregates does not occur, minimise risk of air voids, and avoid material and water from contaminating the pile. Concrete will be over poured to remove any excess material, water or contamination at the top of the pile, while excess water from the pile is pumped to the settlement tanks to be treated and monitored prior to discharge into the sewer system. Excess water from the piles to be treated with CO2 and flocculent to balance the pH and induce sedimentation respectively as well as samples sent to a testing laboratory as required. Temporary casings will be carefully extracted using the piling rig to maintain integrity of the concrete which will be cast to site level. For the type 2 piles, starter cages will be puddled into the concrete wet and set to height following the concrete pour.

3.12. Retaining Structures

Following the temporary retaining structures along Robson Alley, the retaining wall construction will commence. Floor slab will be formed and poured to ground with vertical starters for wall panels. Field Drain will then be laid. Panels will be cast in Christchurch yard and delivered to site with drossbachs and shear key joints. Once the slab has cured, precast panels will be erected and propped back to slab. Panels will be set to height with shims and checked for level and plumb before being grouted in place. Finger beams will be formed and poured to ground.

3.13. Tidy Site and Disestablishment

Once the enabling works are complete, any disturbed areas around the site will be made good. Machinery and plant will be demobilised from site. All waste will be removed from the site and the site will be tidied.