

# Western Harbour Tunnel

## Stage 1

January 2023



## Ground movement, vibration and ground-borne noise factsheet

This factsheet provides information about ground movement and vibration including what causes it, how we manage it and the property damage claim process.

### Ground Movement

Ground movement can be caused by many different factors, such as seasonal climate variations, vegetation and a natural process known as shrink-swell. Construction-related ground movement or settlement can also occur along the project alignment where tunnelling is carried out.

On occasion ground movement can be caused by groundwater drawdown after tunnelling, where clay soils dry out and shrink. A certain amount of ground movement is allowed, with limits set by the Department of Planning and Environment (DPE). This is outlined in [Condition E104](#) of the Western Harbour Tunnel project's (the Project) Conditions of Approval.

Prior to starting construction, John Holland CPB Contractors (JHCPB) prepared an assessment of the expected ground movement within the local area.

The expected ground movement is generally less than the historically recorded shrink-swell movement in the Rozelle, Balmain and Birchgrove areas, and is not expected to cause any structural damage to properties.



Western Harbour Tunnel Stage 1 alignment with highlighted 50 metre radius

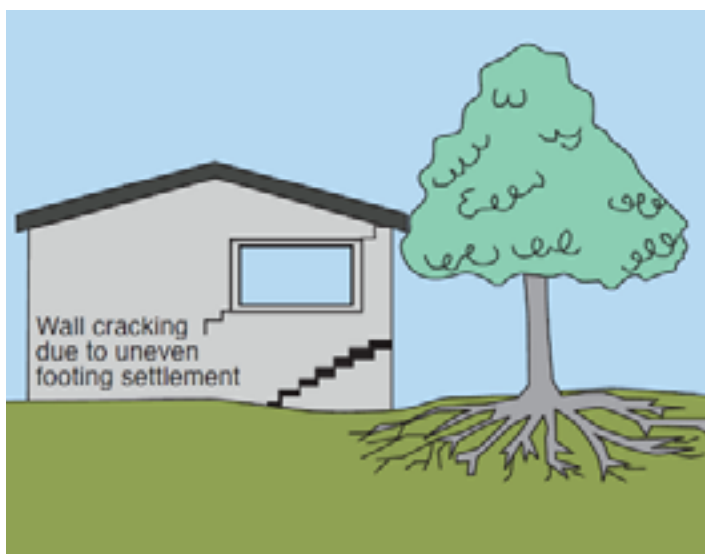
## What is shrink-swell?

Shrink-swell refers to the way clay soils move downwards, upwards and horizontally, depending on the reactivity of clay soil beneath and around a property. Other factors such as the depth and distribution of clay, and changes in moisture content, can also contribute to seasonal shrink-swell. Moisture changes are the result of a combination of factors, and may include:

- seasonal and long-term climate variations including dry summers, extended wet seasons, floods and droughts,
- the influence of buildings, garden coverage, drainage and trees which may contribute to drying out of the underlying soils,
- the long-term effects of urban infrastructure including paving and drainage, and
- the prevailing moisture conditions of the ground, or any recent disturbance such as demolition, renovation of an existing house or removal of large trees/vegetation.

Studies of shrink-swell in Sydney have indicated an annual range of up to 40mm of movement since 2003. This movement has correlated with a rise in the reporting of noticeable and often sudden cracking in houses across Sydney and NSW. Between December 2018 and January 2020, the average movement of the ground surface in several areas across the Rozelle Interchange Project has been about 20mm.

Movement during this period may be attributed to heavy rain events between June 2019 and October 2019, the recent drought and hot dry summers in late 2019 and further heavy rains in February 2020. Conditions like this cause shrink-swell, particularly in suburbs with soils that have high clay content, like the Rozelle and Balmain areas.



Trees can cause shrinkage and damage to property

The CSIRO publishes a useful and easy to read guide to homeowners wishing to mitigate against shrink-swell changes in their home, [A Homeowner's Guide \(2003\)](#).

## Monitoring ground movement

JHCPB has an extensive ground monitoring program in the local area. The ground monitoring program measures both surface and sub-surface ground movement and provides important information to JHCPB and regulatory authorities on how the ground behaved before, during and after all construction activities. It includes thousands of monitoring points along the tunnel alignment such as:

- precision survey targets, which are often attached to roads, footpaths, and the facades of buildings
- electronic remote reading instruments, often placed in the lowest point of building basements
- in-ground geotechnical instruments
- groundwater monitoring wells
- below-ground monitors, which provide JHCPB with baseline information about the seasonal (natural) behaviour of the ground.

These monitoring devices measure minute changes in ground levels that cannot be seen on the surface. Data is also gathered from locations remote to the Western Harbour Tunnel works to form a baseline model.

All monitoring data from these devices is used to ensure that the amount of ground movement remains consistent with our predictions and within the permitted movement levels.

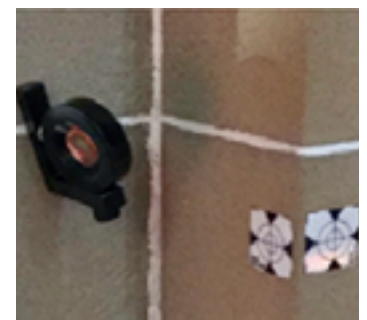
JHCPB has a dedicated monitoring team that includes geotechnical engineers and surveyors, responsible for continually measuring ground movement.

Data is gathered, assessed and monitored in daily meetings between the construction, geotechnical and surveying teams to identify any notable ground movement within the local area.

This process is overseen by Transport for NSW and the Independent Certifier for the Project.



An underground monitor in a basement



Survey targets on the facade of a building

# Vibration and Ground-borne Noise

## Vibration

During tunnelling some residents and businesses along the tunnel alignment may experience vibration when we are using vibratory equipment such as roadheaders.

The level of vibration is dependent on the area's geology, the intensity and frequency of vibration, the distance from the vibratory source and the construction type of a building.

People are able to "feel" vibration at levels far lower than those required to cause even superficial damage to the most susceptible of building. An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

The Project's Conditions of Approval require equipment and work methods that keep vibration well below levels that are likely to cause cosmetic or structural damage to properties (7.5mm/sec).

JHCPB carries out on-site vibration monitoring regularly with results to date never exceeding 1.0mm/sec at a property. The human comfort level for vibration is much lower than this (0.5mm/sec) which means that while you may notice vibrations, they are highly unlikely to cause damage to your property.

## Ground-borne Noise

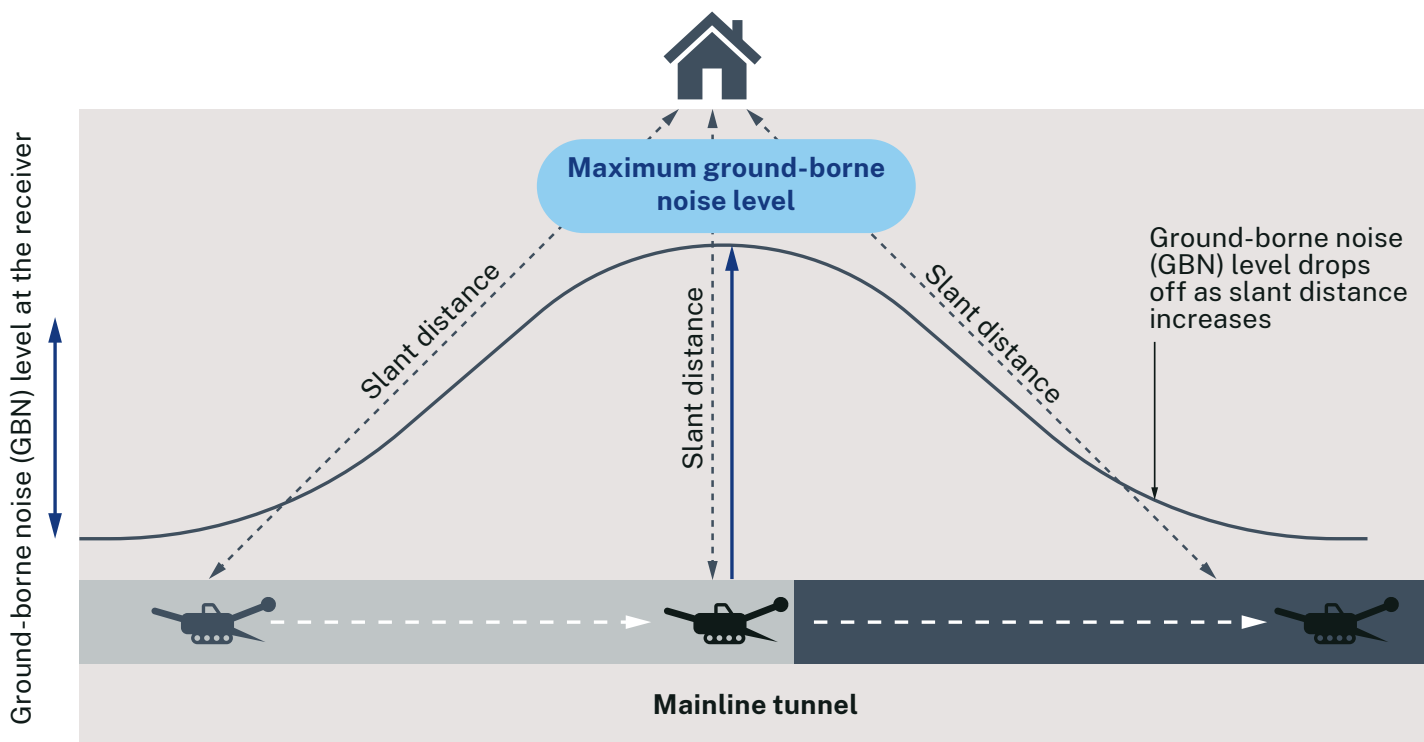
Noise from tunnelling is called ground-borne noise, which passes through the ground and into a built structure, resulting in audible noise levels.

Ground-borne noise from tunnelling activities results from vibration being transmitted through the ground and "regenerated" as noise into a building. It typically has a low frequency "rumbling" sound due to the frequency of the vibrations. Like vibration, ground-borne noise is more noticeable when we are closest to a property, increasing on approach and reducing as we move away.

The Project's Conditions of Approval ([Condition E71](#)) require mitigation measures where ground-borne noise levels are predicted to exceed 35 decibels during the nighttime period. As the majority of our tunnelling on Stage 1 is deep, the Project is not expected to exceed this limit.



Western Harbour Tunnel Stage 1 roadheader excavation



## What gets assessed in a damage claim?

JHCPB follows a detailed assessment process when investigating any damage claimed. This process is shown in the flow chart across.

Each property damage claim is treated uniquely and typically involves consideration of the following:

- the information provided by the property owner and gathered during the site-specific visit,
- the type of work being undertaken near the property,
- the property's location in relation to the project,
- the tunnel excavation progress,
- historical development applications associated with the property,
- the pre-existing state of the property captured in the property condition survey,
- geotechnical conditions under the property,
- ground movement and monitoring data,
- shrink-swell and weather patterns,
- materials used when constructing the property
- changes to the property e.g. trees being removed or renovations, and
- the property's age.

If you suspect that the Western Harbour Tunnel Stage 1 works have contributed to damage of your property, we recommend you contact the project to start the damage claim process as soon as possible, and not wait until construction is completed in the area. The investigation process usually takes about three weeks to complete, however additional time may be required. A project team member will maintain contact with the property owner throughout the assessment process.

The property owner contacts JHCPB using the contact details on this page

JHCPB provides the property owner with a claim form to complete

The property owner completes the claim form, providing as much supporting evidence and detail as possible

JHCPB visits the property to inspect the damage

JHCPB considers all available data and assesses whether the Western Harbour Tunnel Stage 1 works have contributed to the claimed damage

JHCPB provides the property owner with an outcome to their claim

## Contact us

If you have any questions or would like more information please contact our project team:



1800 931 189



whtbl@transport.nsw.gov.au



nswroads.work/whtportal



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