Transforming property valuation with traffic noise insights

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Transforming property valuation through noise analysis

Consider two identical residential properties: they share the same land size, building type, and they are located on the same street with identical views. Despite these similarities, one property is situated close to a major road at the end of the street, while the other is in a quieter locale, distanced from significant traffic thoroughfares. Anecdotal evidence suggests that residences in quieter areas tend to possess higher market values. However, accurately quantifying this variance and predicting future value fluctuations in light of new infrastructure developments such as roads, rail lines, and airports, has proven challenging. This study aims to address these complexities by exploring the relationship between noise pollution and property valuation, contributing to the broader discourse on environmental impact and real estate economics.

PropTrack and Ambient Maps (Ambient) have collaborated to enhance property valuation by integrating noise modelling data into PropTrack's Automated Valuation Model (AVM). The primary objective was to assess how noise pollution from transport sources, such as roads, rail, and aircraft, impact residential property values. Additionally, the study aimed to quantify the degree to which different types of transport noise affect property values, offering nuanced insights into the range where noise levels significantly influence these values. By answering these questions, the collaboration endeavoured to improve the accuracy of property valuations and provide more comprehensive context for real estate valuations, assisting homebuyers, developers, and urban planners in understanding the intricacies of noise pollution on property markets.

This integration not only aims to improve PropTrack's AVM performance but also offers crucial context for understanding how various data points contribute to property valuation. Overall, the project highlights a commitment to advancing real estate valuation practices using innovative data integration, AI, and modelling techniques, potentially setting new standards in the industry.

PropTrack overview

PropTrack is a leading provider of property data, analytics, market insights, and digital valuation solutions in Australia. PropTrack utilises AI, unique data, and machine learning engineering capabilities to power new digital experiences on platforms such as realestate.com.au, as well providing products and services to the valuations industry. PropTrack leverages many data resources, including exclusive access to realestate.com.au's first-party data to operate the most accurate AVM in the country. The AVM is key to providing instant property value estimates that align closely with physical appraisals, serving major Australian lenders and supporting a significant portion of home loans in Australia.

PropTrack makes the AVM available through innovative tools such as realEstimate™ on realestate.com.au, which enables homeowners to track property values and make informed decisions about their property investments. PropTrack's commitment to innovation and accuracy has established it as the market leader in automated property valuation, with investments in AI and data science helping to continually enhance its offerings. The company's solutions drive transparency, efficiency, and innovation in the property sector, making it a crucial partner for businesses seeking to leverage property data effectively.

⌂ PropTrack

Ambient overview

Ambient is a leader in advanced geospatial intelligence, specialising in the development of precise, large-scale noise and air quality data models. By leveraging expertise in spatial data and predictive modelling, Ambient creates 3D models of noise and air quality data for every facade of every level of every building and open space in the nation. Through data analytics, modelling, and location intelligence, Ambient provides unique insights that enhance real estate forecasting, smart city design, urban infrastructure planning and research.

Specifically, Ambient develops and transforms raw noise and air quality data into actionable insights. Through collaboration with the Australian Urban Research Infrastructure Network (AURIN) and through the Archistar.ai research platform, Ambient offers:

• High-resolution noise and air quality mapping for property investment and urban planning.

• Noise and air analysis for smarter real estate valuations.

• Data-driven solutions that help investors identify undervalued assets.

• Individual property noise and air quality reports, detailing precise data for each property and how it compares to other properties in the neighbourhood and state.

• Customisable noise and air intelligence for smart city planning, environmental impact studies and health research.

Visit ambientmaps.com.au to explore the future of noise intelligence.

Ambient

Integrating environmental noise data into residential property valuation

There's a growing need for property data solutions, such as those provided by PropTrack and Ambient, that address sustainability challenges and environmental risks. Insights into risks, resilience, energy efficiency, and affordability are becoming more crucial, with valuations increasingly sensitive to sustainability initiatives.

The collaboration between PropTrack and Ambient demonstrates this shift by integrating Ambient's sophisticated noise modelling data into PropTrack's leading AVM. This integration not only enhances the reliability of residential property valuations but also provides crucial insights into how transport noise impacts property values. By addressing concerns that modern homebuyers and investors now prioritise, including the potential depreciation tied to environmental noise, PropTrack and Ambient are paving the way towards making environmentally conscious property valuation standard practice.

Why does transport noise impact property value?

For those who live in properties exposed to higher transport noise levels, there are significant impacts on health and amenity. Research by the World Health Organization shows that noise is the second largest environmental problem affecting health after air pollution. Chronic exposure is linked to cardiovascular disease, cognitive impairment, and sleep disturbance. Studies in Europe also suggest that children living or attending school in areas impacted by transport noise tend to score lower on reading comprehension and face more behavioural challenges.

Source: https://www.eea.europa.eu/en/analysis/publications/the-effect-of-environmental-noise-on-children

For investors, transport noise impacts the return on an investment property beyond the overall value of the home. A 2019 study found that properties with high nighttime road noise levels had almost a 70% increase in turnover compared to equivalent quieter properties. Higher vacancy rates result in lower returns for the owner.

Source: https://acoustics.asn.au/conference_proceedings/AAS2019/papers/p64.pdf

The recent work-from-home trend has also triggered a focus on amenity for homebuyers. With the introduction of remote and hybrid working practices, prioritisation of environments that support productivity and wellbeing has become more of a focus. Quiet suburbs or homes with effective noise insulation may be more desirable, which impacts property values.

Comparison of historical studies

Numerous global studies have assessed the impact transport noise has on property value. However, no such study has taken a noise model of Ambient's detail and resolution, over such a massive geographical area, and applied it to an AVM with the power and accuracy of PropTrack's model.

In Australia, the New South Wales Roads and Traffic Authority (RTA) in 1995 suggested that property values depreciate on average between 0.08% and 1.28% for every 1-decibel increase in road traffic noise over 50 dB(A). This finding was based on a review of nine studies published between 1974 and 1980, which returned a weighted average of approximately a 4% drop in property value for every 10 dB(A) increase in road traffic noise. A 1996 study, comprising 350 houses in Brisbane, then found a 10% decrease in property value for every 10 dB(A) increase in noise levels.

Aircraft noise has also been investigated. In 2020, a Sunshine Coast University's (UniSC) study suggested that a drop in property value of around 17% occurred for dwellings within the flight path for Cairns compared to dwellings outside this area.

Source: Impact of Airport Noise on Residential Property Values: Cairns Airport
Journal of New Business Ideas & Trends, Vol. 18 Iss.1, June 2020, pp. 12-20.

A 2013 Queensland University of Technology study, commissioned by the Brisbane Airport Corporation, found that the location of a residential property under a Brisbane flight path has no significant long-term impact on the median and average house price. However, this impact addresses the change in property value, and not the value of the property itself, with the study acknowledging "...the median house price in the aircraft noise affected suburbs was lower than residential property in less or non-affected locations..."

Source: https://www.bne.com.au/sites/default/files/docs/QUT-Report-Impact-of-Aircraft-Noise-on-Brisbane-Residential-Property-1988-2013_0.pdf

Focus of research

This research focused on 1.8 million residential buildings across metropolitan and regional areas of Victoria, Australia. Property value impacts were estimated for the 3.7 million dwellings matched to each building. Consideration was given to proximity to roads, rail and tram lines, and aircraft flight paths. The property valuation model identified how differing environmental noise conditions affect market valuations across the state of Victoria. By incorporating a wide sample of residential dwellings, this investigation offers insights into how residential property valuations are influenced by noise pollution, contributing to a deeper understanding of property market dynamics in relation to environmental factors.

How noise was modelled

The noise models incorporated key geographical features such as ground terrain, noise barriers, ground materials that impact noise reflection or absorption, and footprints for more than 15 million buildings across Australia. Over 1.2 million km of road was included, along with more than 40,000 km of rail network and around 39,000 aircraft movements. The models calculated noise levels across every façade of every level of every dwelling in the nation at three separate time periods – day, evening, and nighttime. The noise levels for the most and least exposed façades of each dwelling were then recorded for each time point.

Noise level:
45 dB(A)

Noise level:
55 dB(A)
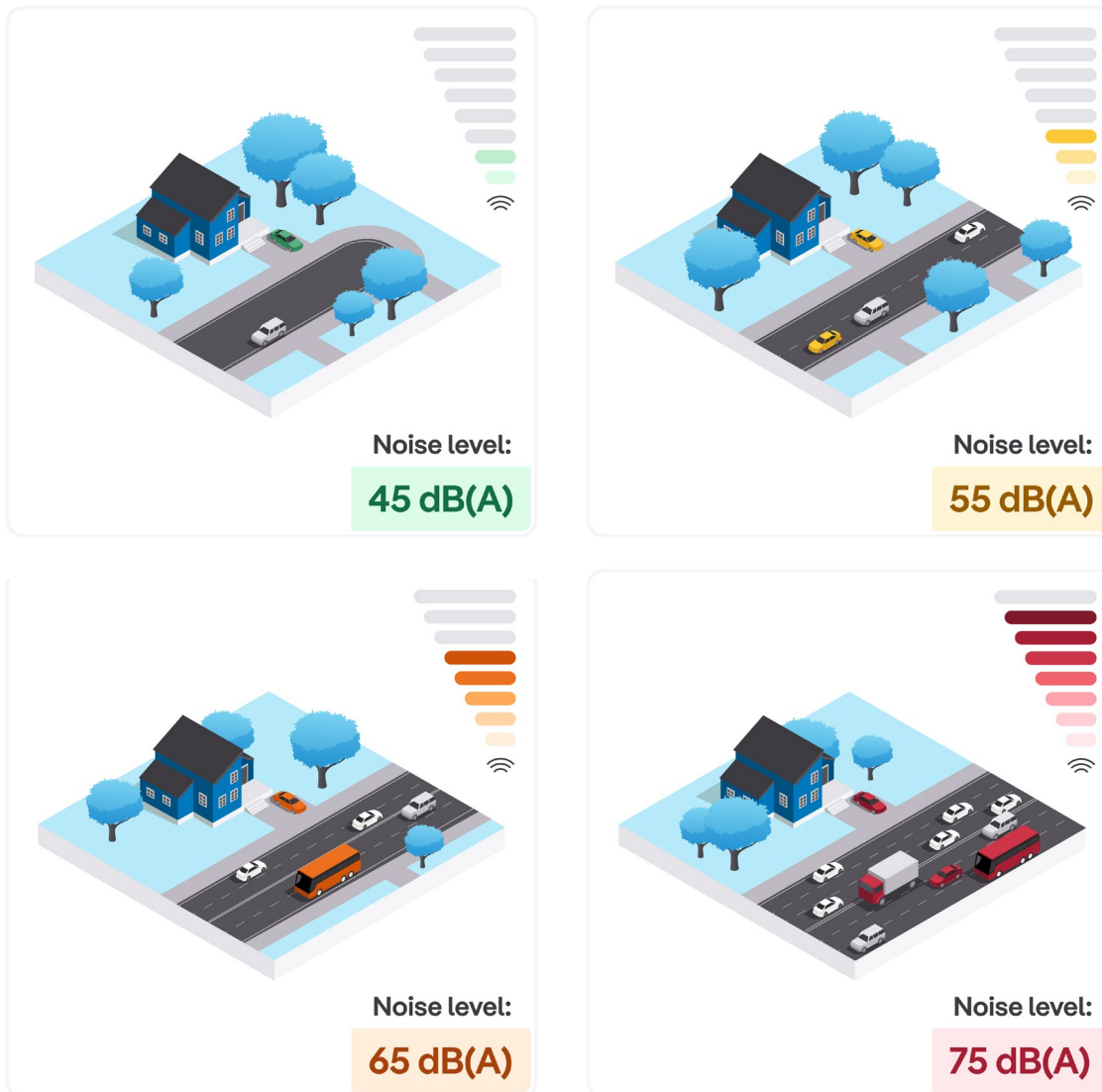
Noise level:
65 dB(A)

Noise level:
75 dB(A)

Image: Depiction of the typical noise level in decibels for four similar houses with increasing road traffic noise.

Original illustration graphics sourced from freepik.com

How property values were modelled

The PropTrack AVM utilises advanced machine learning and AI techniques to estimate residential property values. Benefiting from exclusive access to data from realestate.com.au, it uses a combination of observed sales prices, property location data, consumer demand, and additional market metrics to understand and determine the factors driving property values. The AVM builds on various data sources, including AI generated property quality scores derived from property listing images and other proprietary datasets.

The AVM is designed as part of a cloud-based platform capable of running a suite of real estate models, enabling efficient digitisation of the valuation process. A single API interface allows consistent access to these insights, ensuring seamless integration with customer systems and applications. This infrastructure empowers real estate professionals, banks, and consumers with accurate, real-time property valuations, helping them make informed decisions about the property market.

PropTrack's commitment to accuracy has seen continual enhancements through AI. For instance, recent innovative techniques like generative AI are employed to interpret and improve on property listing descriptions, expanding the data the model can utilise and progressing the AVM to be the most accurate in Australia.

How noise data was integrated into the AVM

The following comprehensive noise modelling data was calculated at a residential property level and linked to the Geocoded National Address File (GNAF) dataset for all properties in Victoria.

Road traffic noise: The maximum and minimum noise levels experienced by properties during day, evening and nighttime hours, taking into account vehicle types, traffic volumes, speed, road surface conditions, and topographical influences including the screening benefits of noise barriers and other buildings.

Rail traffic noise: Similar to road, the rail dataset captures the maximum and minimum noise level across each property produced by all rail sources, distinguishing between heavy rail and tram networks.

Aircraft noise: Noise levels from aircraft activities was considered for day, evening, and nighttime periods, capturing flights from major airports and additional sources such as helicopters. Particular attention was given to the noise impact within the vicinity of major airports (e.g. Tullamarine). The type of each aircraft was considered when calculating the noise levels, along with the speed, elevation, and if the aircraft was taking off, landing, or cruising.

Minimum vs maximum for the day, evening, or night: By addressing noise levels for various façades of properties during different time periods, the model aimed to deliver more accurate assessments for the impact to property valuations.

Methodology

The noise modelling data was merged with PropTrack's residential property data and incorporated into the AVM. Results were assessed on AVMs generated over a five-month period and compared to property sales during that period.

A stronger correlation between the change in transport noise level and impact to property value was noted when using the maximum (most exposed) noise level at each property against the minimum (least exposed).

Regarding the time periods, the evening and nighttime noise levels provide the strongest correlation with changes in property value. These are periods where most of the population are at home and resting. Despite this, this study presents comparable daytime noise level values to provide a common reference as most Australian studies and government criteria and recommendations focus on the daytime noise exposure.

PropTrack is committed to "Explainable AI" principals as part of providing transparency of its AI models. To support the analysis Shapley values, derived from cooperative game theory, were created which provides a systematic approach to determining the contribution of each feature to the valuation model's predictions. The Shapley values for each of the noise variables provided a mechanism to interpret and explain the impact each noise level had on the estimated property value.

Source: "Unlocking the Black Box: How Shapley Values Illuminate AI Decision-Making", AVMNews Volume 23, Issue 6.

Key results

Across both Melbourne and regional Victoria, higher transport noise levels were found to be associated with lower property values, for properties with transport noise levels of above 45 dB(A). This accounts for more than 95% of properties across Victoria.

For roads within Melbourne, an average decrease in property value of 6% was seen for every 10 dB(A) increase in road noise, with greater reductions seen for higher noise level brackets.

For rail, an average decrease of 4% was seen for every 10 dB(A) increase in rail noise, even after accounting for the benefits of the convenience of living near a train line. These results were for all rail, including passenger, heavy rail and trams, although larger negative impacts are associated with heavy rail, in particular freight rail noise, presumably because whilst there are fewer freight movements compared to passenger services, the noise levels are typically louder and there are no amenity benefits.

Aircraft noise was associated with an average decrease of 6-9% for every 10 dB(A) increase in aircraft noise. Given that properties outside the flight path can experience noise levels that are 20 dB(A) less than those within the flight path, the difference in property value may be significant.

For regional Victoria, the results were less significant. For every 10 dB(A) increase in road noise, a 3.5% decrease in property value was seen. For rail, this was a 2.5% decrease. Unfortunately, the impact of aircraft noise in regional Victoria was not able to be calculated due to insufficient data.

↓ ~4% decrease in property value

↑ per 10 dB noise

↓ ~6% decrease in property value

↑ per 10 dB noise

↓ ~6-9% decrease in property value

↑ per 10 dB noise
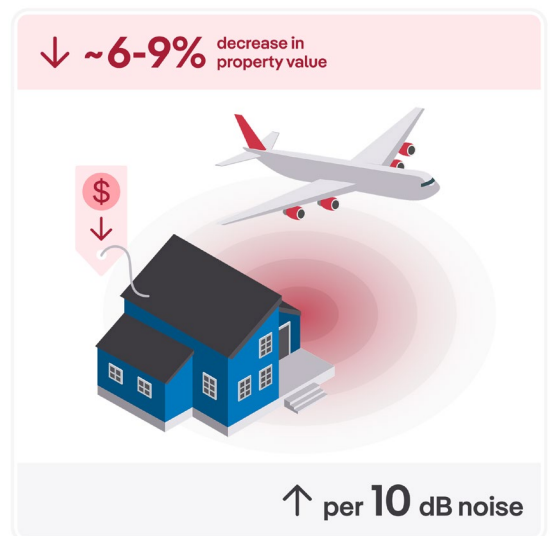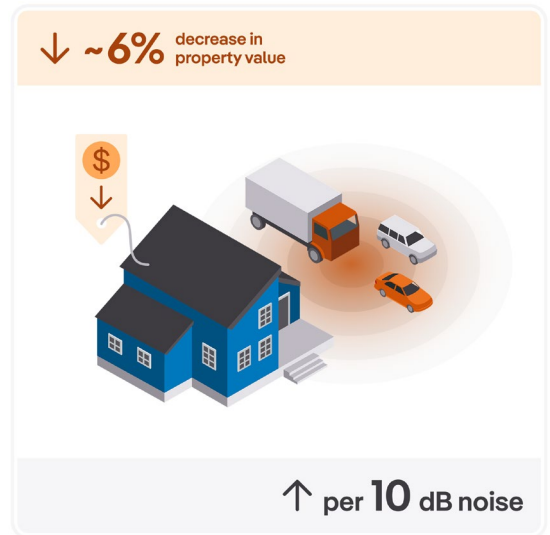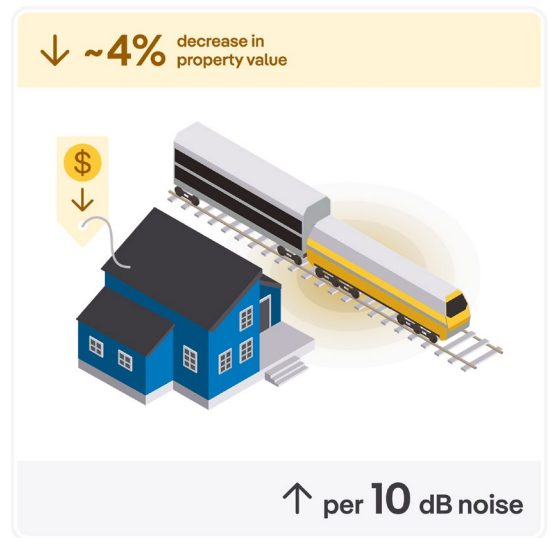
Original illustration graphics sourced from freepik.com

What does this mean?

Unsurprisingly, increases in transport noise result in decreases in property value. Regarding road traffic noise, this study provides a strong alignment with the results published by New South Wales RTA in 1995. Likewise, the impact of aircraft noise on property values under the flight path to Tullamarine is in line with the 2020 UniSC study of properties surrounding the Cairns regional airport. The Brisbane 1996 finding that a 10 dB(A) increase in transport noise levels results in a 10% drop in property value was not observed for Victoria.

The potential inclusion of noise data into the AVM has proven to not only improve the performance of the AVM but also provides context surrounding the contribution of other data points used to determine a property value (e.g. historical sales).

This research indicates that property values may decline in response to noise levels from increased traffic flows from new infrastructure such as highways, railway lines, or airports, which can decrease the desirability of nearby properties.

Importance of using noise modelling data in an AVM

Noise pollution is an important component of Environmental, Social, and Governance (ESG) data which has been shown to play a role in adverse health outcomes. As urban densification increases, there is a greater need to understand the impact of noise levels on both existing and new supply of homes near transport corridors. PropTrack and Ambient support sustainable initiatives that lead to understanding the impact of noise on the health of residents and the values to residential properties.

The integration of ESG data into AVMs is part of a broader trend towards more environmentally conscious and responsible property valuation. As ESG data becomes more available and reliable, AVMs will increasingly utilise it to provide valuations that reflect the growing importance of sustainability in the real estate market. This incorporation of ESG data helps ensure that property valuations consider factors beyond traditional financial metrics, aligning with contemporary demands and enhancing the accuracy and comprehensiveness of valuations.
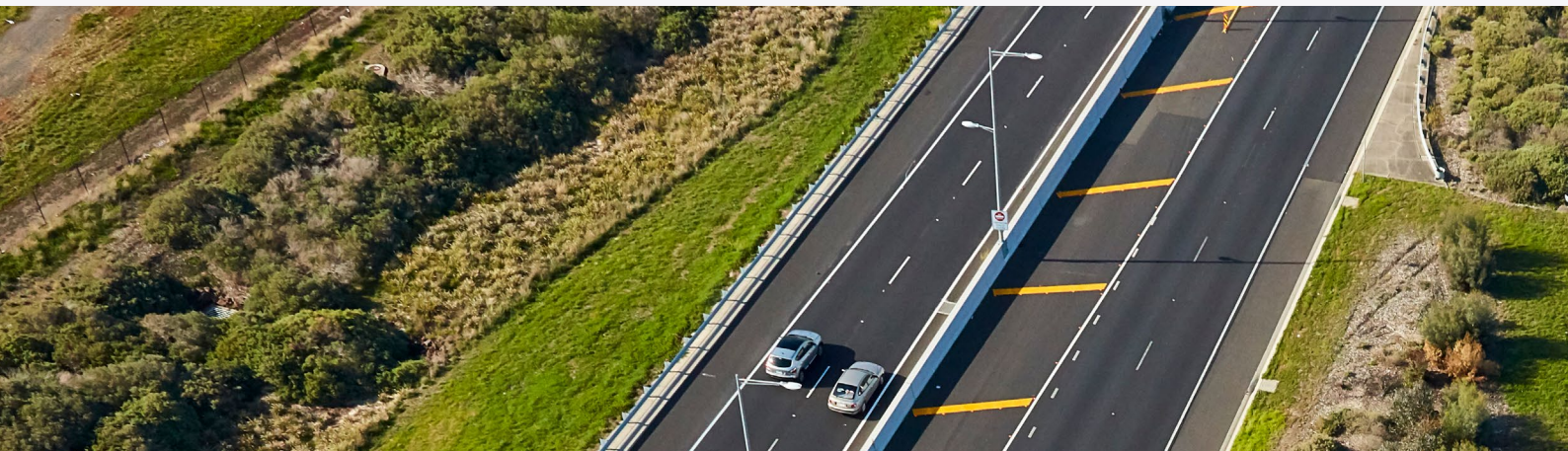
About the authors

Ben Hinze

Ben Hinze is a leading expert in environmental noise mapping and acoustic engineering, with over 26 years of experience in transport infrastructure, environmental assessments, and GIS-based noise modelling. As the Director of Ambient, Ben has been at the forefront of major transport noise mapping projects, both in Australia and overseas.

Recognised for his ability to bridge environmental data with real-world applications, Ben has played a critical role in shaping government noise policies. His work spans high-profile projects such as the M1 Pacific Motorway, Bruce Highway, Gateway Motorway, and Coomera Connector, where he has led noise and vibration assessments to inform infrastructure planning and mitigation strategies. His published research on noise pollution has also been presented at major acoustics and engineering conferences worldwide. Through his leadership, the field of strategic noise mapping is evolving to provide deeper insights into how transport noise affects property values, urban development, and public health.

Ben holds a Master's in Acoustics and Noise Control, a Master's in GIS, and is a Registered Professional Engineer of Queensland (RPEQ) and a Chartered Professional Engineer (CPEng). His dedication to data-driven environmental solutions continues to push the boundaries of noise mapping and real estate analytics.

About the authors

Kevin Ward

Kevin Ward is an accomplished leader in data science, machine learning, and analytics, and is currently an Executive Manager at PropTrack, part of REA Group in Australia. With over two decades of experience across real estate, finance, and technology, Kevin has been instrumental in driving innovation and excellence in AI-driven solutions and property market insights.

Kevin leads the development of Australia's most advanced automated valuation models and market insights platforms that enhance the precision and reliability of property valuations. His work is characterised by a focus on integrating cutting-edge AI technologies and fostering high-performing multidisciplinary teams.

Kevin holds an MPhil in Intelligent Systems Engineering and has been a featured speaker at industry conferences and webinars. Kevin's commitment to advancing the field is reflected in his contributions to urban density and property value research, influencing both industry standards and policy decisions.

The collaboration between PropTrack and Ambient brings together scientific modelling and AI-driven residential property valuation techniques, advancing the use of environmental noise data in property markets. It has demonstrated how models can be created to quantify the impact of detailed transport noise data and improve valuation accuracy through an advanced understanding of noise pollution's impact on property values.

Acknowledgements

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