SOUTH-EAST SCANNING

GPR Scanning and Moisture Assessment Report for Norfolk Island Regional Council Burnt Pine, Norfolk Island

Ground penetrating radar, structural analysis, and utility detection specialists.

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ABOUT US

South-East Scanning is a Queensland-based NDT consultancy specialising in ground penetrating radar (GPR), utility locating, and non-destructive testing of concrete and subsurface structures.

Founded by brothers Aidan and Dion Waszaj, the company was established to deliver a higher standard of subsurface investigation across South-East Queensland. With a focus on accuracy, clarity, and practical outcomes, South-East Scanning supports engineers, contractors, and asset owners in making informed decisions where subsurface conditions are uncertain.

Operating across the Sunshine Coast, Brisbane, and the Gold Coast, the team delivers high-resolution GPR surveys, void detection, structural assessment, and utility mapping, with an emphasis on risk mitigation and clear, decision-ready reporting.

We combine advanced technology with field experience to deliver reliable insight in complex environments, from residential construction through large-scale civil and infrastructure projects.

ONGOING SUPPORT

Subsurface conditions often require staged investigation and verification.

South-East Scanning is available to support throughout the next phase of works, including on-site support, additional scanning, and real-time interpretation during remediation to ensure outcomes align with this report.

For further information, please contact our team.

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SUBSURFACE INVESTIGATION SPECIALISTS.

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Executive Summary

South-East Scanning was engaged by the Norfolk Island Regional Council to undertake a non-destructive investigation of the concrete slab system at the Norfolk Island Tourist Centre, Burnt Pine, in response to ongoing moisture ingress, mould-related concerns, visible cracking, and suspected subfloor deterioration.

The investigation incorporated high-resolution ground-penetrating radar (GPR) scanning, moisture mapping, reinforcement assessment, and visual inspection of both the internal slab system and surrounding external conditions.

The investigation identified widespread elevated moisture conditions throughout multiple areas of the building, with the highest readings and most pronounced slab anomalies generally occurring adjacent to the external perimeter. Visual inspection identified inadequate surface drainage and evidence of water accumulation around the structure, while impermeable internal floor finishes appear to limit slab evaporation and contribute to long-term moisture retention within the concrete system.

Ground-penetrating radar data across most investigation areas exhibited irregular, non-uniform responses that were inconsistent with a homogeneous slab-on-ground system. Subsurface anomalies identified throughout the slab included disrupted reflections, irregular reinforcement cover, diffuse signal behaviour, and deeper anomaly zones consistent with localised voiding, potential delamination, reduced material homogeneity, and variable slab support conditions. Several areas also exhibited significant cracking associated with elevated moisture and anomalous GPR responses. The most significant areas of concern were identified within the Front Office, North Corner, and Centre Area locations.

Executive Summary (cont.)

The observed conditions are considered consistent with a slab system affected by chronic moisture ingress over an extended period, likely exacerbated by inadequate perimeter drainage, moisture-retentive volcanically derived subgrade materials, and restricted vapour dissipation beneath existing floor coverings.

While the investigation identified multiple indicators of localised slab distress and subsurface irregularity, the findings did not conclusively demonstrate immediate or catastrophic slab failure that would require wholesale demolition or full slab replacement at this stage.

Based on the available non-destructive data, South-East Scanning considers that targeted intrusive investigation should be undertaken before any decision regarding full slab replacement is made. The investigation findings suggest that portions of the slab system may remain suitable for remediation, subject to confirmation of slab integrity and the extent of any localised voiding or deterioration. Recommended next steps include drainage improvement, targeted intrusive verification, ongoing monitoring, and consideration of moisture mitigation and concrete densification systems where appropriate.

Overall, the investigation indicates that the building slab system is experiencing long-term moisture-related deterioration and variable subsurface conditions, but does not currently demonstrate clear evidence of complete systemic structural failure. We recommend further verification to determine whether localised remediation, partial replacement, or broader intervention is ultimately required.

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Scope of Works

South-East Scanning was engaged by the Norfolk Island Regional Council to undertake a non-destructive investigation of the concrete slab system at the Norfolk Island Tourist Centre, Burnt Pine. The purpose of the investigation was to assess the condition of the slab in relation to reported moisture ingress, cracking, and subfloor-related issues, and to identify potential contributing factors.

The scope of work included a targeted assessment of internal slab areas where moisture-related concerns and visible defects had been reported. This involved using ground-penetrating radar to assess slab composition, reinforcement layout, and subsurface conditions, alongside surface moisture testing to evaluate the distribution and relative severity of moisture within the slab.

In addition, a visual inspection of internal slab conditions and the external building perimeter was undertaken to identify potential sources of moisture ingress, including drainage deficiencies and areas of water accumulation adjacent to the structure.

Collected data was processed and analysed to identify patterns of moisture distribution and subsurface anomalies, with the aim of providing a consolidated understanding of the slab's performance and the likely mechanisms contributing to the observed issues.

This report presents the findings of the investigation and provides recommendations for further action based on the observed conditions.

Methodology

A non-destructive investigation was undertaken at the Norfolk Island Tourist Centre in Burnt Pine, Norfolk Island, to assess the condition of the concrete slab and identify potential causes of moisture ingress and associated defects. The methodology was designed to provide a high-resolution understanding of slab composition, subsurface conditions, and moisture distribution, while minimising disruption to the building.

Ground-penetrating radar (GPR) scanning was carried out at seven discrete locations within the structure using a Proceq GP8000. Survey grids were established at spacings of approximately 50 mm to 100 mm, depending on access constraints and the level of detail required. This approach enabled detailed mapping of reinforcement layout, estimation of concrete cover, and identification of subsurface anomalies within and beneath the slab. Both B-scan and depth-slice (C-scan) data were collected to assess slab uniformity, detect potential voiding, and identify areas of irregular response indicative of material inconsistency or degradation.

GPR datasets were processed and analysed using Geolitix software. This included generating depth slices to visualise subsurface conditions at varying depths, enabling improved identification of anomaly zones and correlation with observed surface features. Interpretation of the data focused on identifying patterns of inconsistency within the slab and beneath the reinforcement layer, rather than relying on isolated reflections.

Concrete cover measurements obtained from GPR were cross-checked using a Proceq Profometer PM8000 to verify reinforcement depth and improve confidence in the interpreted slab profile. This dual-method approach provided an additional layer of validation, particularly in areas where GPR data were less clear due to moisture or material variability.

Surface moisture conditions were assessed using a non-destructive impedance-based moisture meter (Tramex CMEX5). Measurements were taken in a grid pattern at each investigation area to provide comparative moisture readings across the slab surface. This enabled the identification of moisture distribution patterns and gradients, which were used to infer potential ingress pathways and areas of concentration.

A visual inspection of the internal slab surfaces and external building perimeter was also undertaken. This included assessment of cracking, floor finishes, slab interfaces, and visible indicators of moisture such as efflorescence and mould. External conditions, including drainage, surface grading, and evidence of water pooling adjacent to the structure, were documented to provide context for the internal findings.

The collected datasets were reviewed collectively to identify correlations between moisture distribution, structural features, and subsurface anomalies. Interpretation of GPR data was undertaken with consideration of site-specific conditions, including the presence of moisture-retentive, volcanically derived subgrade materials, which are known to influence signal response and attenuation.

It is noted that ground penetrating radar and impedance-based moisture testing provide indirect indicators of subsurface conditions. While these methods are effective for identifying patterns and anomalies, confirming specific defects or material conditions may require intrusive investigation, which demands greater certainty.

Observations and Results

General Observations

Assessment of the slab across all investigation areas identified consistent patterns in both moisture distribution and subsurface response.

Elevated moisture readings were recorded at most tested locations, with values generally ranging from approximately 4.0% to 5.5%, and localised peaks exceeding 6.0% in certain areas. Higher moisture concentrations were typically observed adjacent to the building perimeter, with comparatively lower but still elevated readings recorded toward internal zones.

Drainage Concerns

Visual inspection of the building's exterior perimeter revealed evidence of inadequate drainage, including water pooling adjacent to the structure. Minimal drainage infrastructure was observed, and existing measures appeared insufficient to effectively divert surface water away from the building. Efflorescence was noted on the external slab surfaces, further indicating ongoing moisture movement through the concrete.

Floor Coverings as a Contributing Factor

Internally, the slab is covered with a combination of carpet and floating floor finishes. These materials are likely limiting evaporation from the slab surface and contributing to moisture retention within the concrete. Long-term mould issues reported at the site are consistent with these conditions.

GPR Scanning

Ground-penetrating radar data across all locations were generally inconsistent and lacked the uniformity typically associated with a sound slab-on-ground system. Rather than clear, continuous reflections indicating a consistent slab profile, the data exhibited significant variability, including irregular reinforcement cover, diffuse reflections, and pronounced horizontal banding beneath the reinforcement layer. Subsurface anomalies were identified across multiple areas, with responses consistent with localised voiding, potential honeycombing, and zones of reduced material homogeneity. In several locations, the bottom of the slab was difficult to define, further indicating irregularities in slab construction and/or underlying conditions.

Cracking as Indicators

Cracking was observed at multiple locations, including both diagonal and longitudinal patterns. Cracks were often associated with areas of elevated moisture or proximity to external slab edges.

Geotechnical Indicators

Norfolk Island is characterised by volcanically derived soils formed from weathered basalt and volcanic ash deposits. These soils are typically moisture-retentive and can exhibit variable density, shrink-swell behaviour, and inconsistent bearing characteristics depending on drainage conditions and the degree of weathering.

From a geotechnical perspective, prolonged moisture ingress and poor surface drainage may contribute to softening of near-surface subgrade materials, localised loss of support beneath slab-on-ground systems, and differential slab movement over time. The moisture-retentive nature of the soils can also influence ground-penetrating radar performance by increasing signal attenuation and contributing to diffuse or inconsistent subsurface reflections.

Investigation Areas

Location 1

Location 1 was assessed using a high-resolution grid with approximately 50 mm scan spacing. A diagonal crack was observed in the slab near the external building edge.

Moisture readings in this area ranged from approximately 4.0% to 5.5%, with higher values generally concentrated toward the perimeter. GPR data indicated reinforcement cover in the order of 100 mm to 120 mm, with minor subsurface anomalies identified. Localised responses consistent with voiding were observed, and depth-slice analysis indicated anomaly patterns aligning with the observed crack orientation.

Location 2 – Front Office

Location 2 exhibited some of the most pronounced indicators of slab distress.

Moisture readings ranged from approximately 4.4% to 6.9%, representing the highest recorded values across all investigation areas. Longitudinal cracking was observed, and reinforcement cover was highly variable, with some areas having less than 30 mm.

GPR data was notably irregular, with poor signal clarity and strong, contrasting reflections. Subsurface responses were consistent with voiding and potential delamination effects. The slab bottom was not clearly defined in several areas, and overall data quality indicated significant material inconsistency and elevated moisture levels.

Location 3 – Boardroom

Location 3 was assessed using approximately 100 mm grid spacing.

Moisture readings in this area were comparatively lower, generally ranging between 3.7% and 5.0%, although still indicative of elevated moisture presence. An expansion or construction joint was identified, and detachment of skirting boards was observed.

GPR data remained inconsistent, with subsurface reflections indicating possible underlying features or anomalies beneath the primary reinforcement layer. While this area did not exhibit the same level of distress as Location 2, the slab response was still inconsistent with that of a uniform, well-constructed system.

Location 4 – North Corner

Location 4 displayed clear evidence of moisture-related distress near the building perimeter.

Moisture readings ranged from approximately 2.8% to 6.5%, with elevated values concentrated along one side of the grid. A significant crack or joint was observed, and the presence of a deteriorated moisture barrier was visually confirmed within the crack.

GPR data in this area was particularly noisy, with strong reflections and irregular patterns observed near the external wall. These responses are consistent with increased moisture presence and potential subsurface irregularities in areas subject to ongoing ingress.

Location 5 – East Corner

Location 5 was assessed over a smaller grid area and included the detection of the slab-edge beam.

Moisture readings ranged from approximately 4.3% to 5.2%, indicating moderate but consistent moisture presence. GPR data identified variations in subsurface response, with anomalies consistent with voiding and/or localised material inconsistencies.

Deeper reflections observed in the data suggest irregular conditions beneath the slab, potentially associated with subgrade variability or moisture accumulation.

Location 6 – Central Area

Location 6 was assessed using a high-resolution grid with approximately 50 mm spacing.

Moisture readings were relatively consistent across this area, generally ranging between 4.4% and 5.3%. A longitudinal crack greater than 1 mm in width was observed, located directly beneath the reinforcement layer.

GPR data was highly variable, with inconsistent reinforcement cover and widespread irregular reflections. Subsurface responses indicated reduced material homogeneity and possible voiding. Despite being centrally located, this area exhibited characteristics like those of perimeter zones, suggesting that moisture-related effects are not confined to slab edges.

Location 7

Limited data was collected at Location 7 due to access and size constraints. Available measurements indicated average moisture readings of approximately 4.5%, consistent with the broader slab conditions.

Overall Interpretation

The investigation identified widespread moisture ingress, inconsistent subsurface conditions, and localised slab distress across multiple areas of the building. Ground penetrating radar data exhibited non-uniform responses throughout the slab system, including anomaly patterns consistent with possible voiding, delamination, reduced material homogeneity, and variable slab support conditions.

The most significant areas of concern were identified within the Front Office, North Corner, and Centre Area locations, where elevated moisture levels, visible cracking, irregular reinforcement cover, and disrupted subsurface responses were observed.

Despite these findings, the investigation did not identify conclusive evidence of immediate or catastrophic slab failure throughout the structure. The observed conditions appear localised and variable in severity rather than indicative of uniform slab collapse or complete systemic failure.

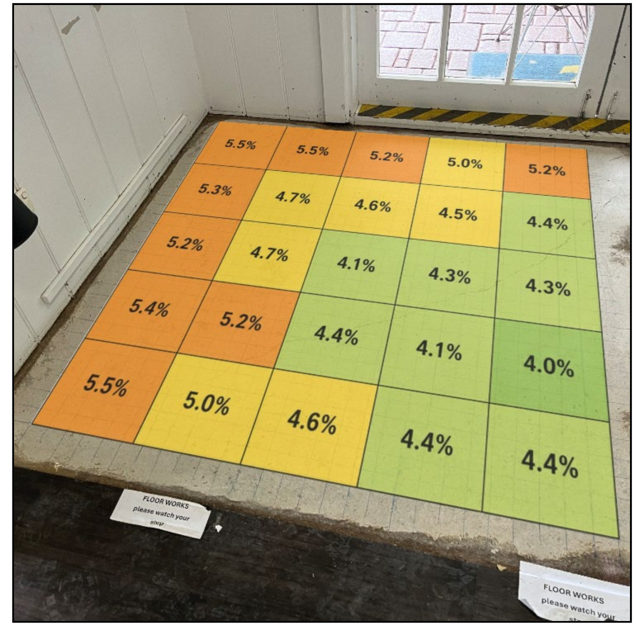
Based on the available non-destructive data, full slab replacement cannot presently be justified with high certainty. However, the identified anomalies are sufficiently significant to warrant targeted intrusive investigation in the most affected areas to confirm slab condition and determine whether localised remediation or partial replacement may be required.

It is recommended that drainage improvements and moisture management measures be prioritised, alongside targeted intrusive verification, before major demolition or replacement decisions are made.

Location 1 (Foyer Area): Data and Interpretation

Depth slice: 100mm depth (mesh layer)

Depth slice: Subsurface layer (200-300mm)

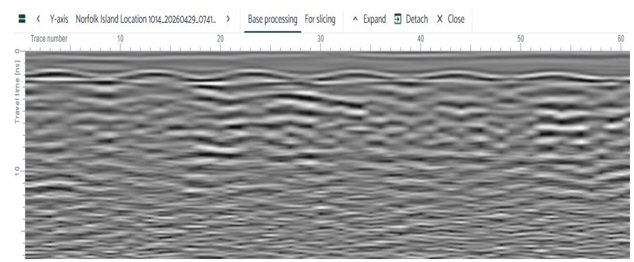


Moisture map

Integrated Data Interpretation

Moisture mapping indicates a clear gradient across the slab, with elevated levels toward the external edge, consistent with lateral ingress. GPR depth slices identify localised zones of elevated response beneath the reinforcement layer, suggesting subsurface irregularities that may be associated with moisture accumulation or minor voiding.

B-scan data is diffuse and non-uniform, indicating variability within the slab and underlying subgrade. Overall, the slab does not exhibit the consistent response expected of a dry, uniform slab-on-ground system.



B-scan: Sample GPR profile

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Location 2 (Front Office): Data and Interpretation

Depth slice: 100mm depth (mesh layer)

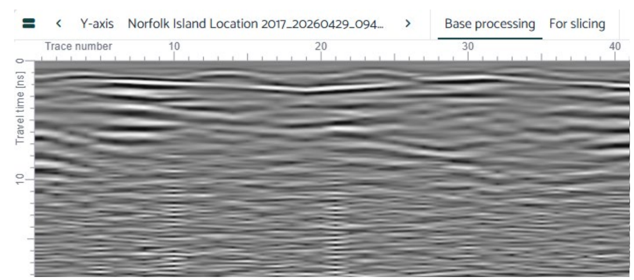
Depth slice: Subsurface layer (200-300mm)

Moisture map

Integrated Data Interpretation

Moisture mapping identified a localised elevated moisture zone within the centre of the slab, with readings up to 6.9%. Visual inspection identified longitudinal cracking, while GPR analysis indicated very low concrete cover in some locations (<30 mm) and an irregular slab base profile. B-scan and depth-slice data exhibited diffuse reflections, bright, contrasting hyperbolas, and disrupted signal continuity, consistent with localised voiding and possible delamination beneath or within the slab system.

Overall data quality was poor due to heterogeneous subsurface conditions and signal scattering.



B-scan: Sample GPR profile

Location 3 (Boardroom): Data and Interpretation

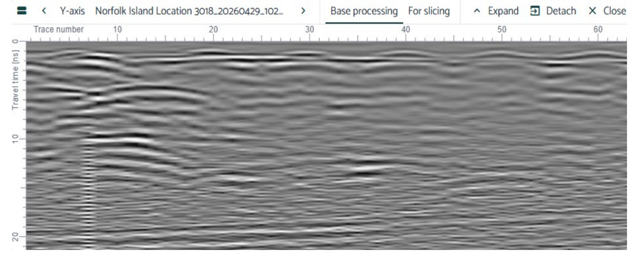
Depth slice: 100mm depth (mesh layer)

Depth slice: Subsurface layer (200-300mm)

Moisture map

Integrated Data Interpretation

Moisture mapping identified generally moderate and relatively uniform moisture levels across the boardroom slab, with isolated elevated responses toward the external edge. Visual inspection identified an expansion joint and detached skirting board adjacent to the affected area. The slab surface also incorporated stamped concrete, contributing to variable signal response during testing. GPR depth slice analysis identified a prominent linear elevated reflection corresponding with a visible slab crack within the deeper subsurface layer. B-scan and depth slice data quality was generally poor across this location due to heterogeneous slab conditions and surface interference; however, the data suggests localised subsurface irregularities and moisture migration associated with the cracked section of slab.



B-scan: Sample GPR profile

Location 4 (North Corner): Data and Interpretation

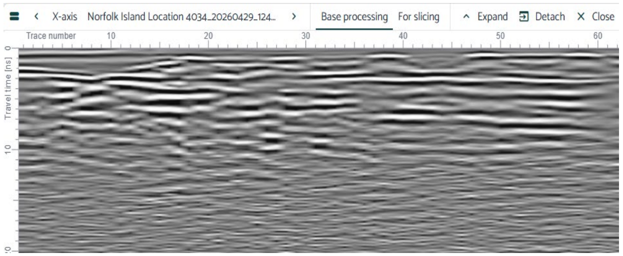
Depth slice: 100mm depth (mesh layer)

Depth slice: Subsurface layer (200-300mm)

Moisture map

Integrated Data Interpretation

Moisture mapping identified elevated readings across the central and upper portions of the slab, with localised very high responses up to 6.5%. GPR data was collected at 100 mm scan spacings and identified irregular subsurface responses below the reinforcement layer. These deeper GPR responses did not align perfectly with the surface moisture readings, suggesting the anomalies are not solely moisture related and may also reflect variable slab support, cracking, a deteriorated moisture barrier, or localised voiding. A significant linear feature was observed along the left side of the slab, corresponding with a visible joint or crack. A deteriorated moisture barrier was visible within this feature, and the skirting board was noted to be separated from the slab perimeter. No obvious cracking was observed elsewhere; however, the combined data indicates localised subsurface irregularity associated with the apparent joint.

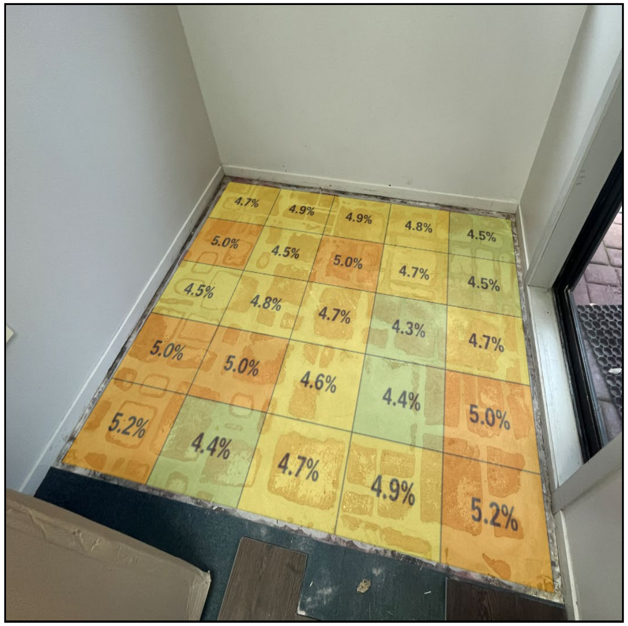


B-scan: Sample GPR profile

Location 5 (East Corner): Data and Interpretation

Depth slice: 100mm depth (mesh layer)

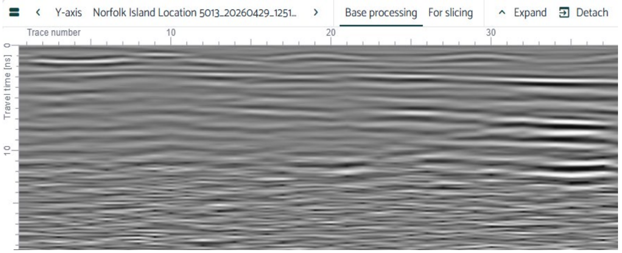
Depth slice: Subsurface layer (200-300mm)



Moisture map

Integrated Data Interpretation

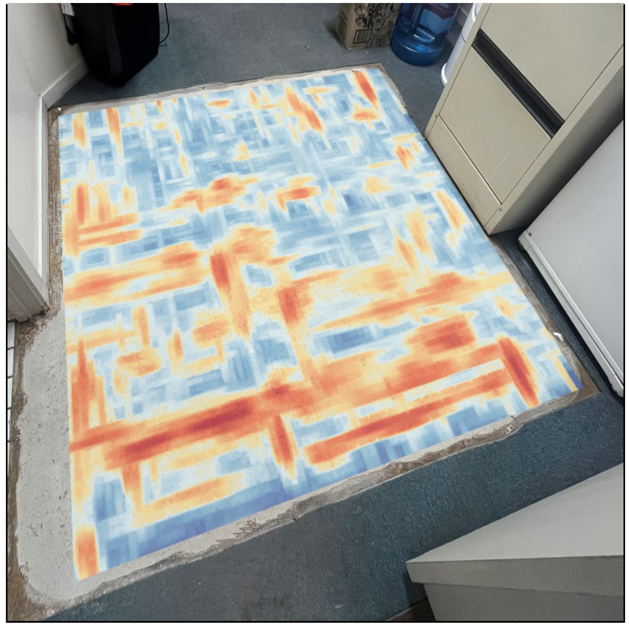
Moisture mapping within the east corner area identified generally moderate moisture levels across the slab, with lower overall readings compared to previous locations. GPR data was collected at 100 mm scan spacings over a slightly smaller survey area. An edge beam was identified along the slab perimeter, producing a strong linear reflection within the reinforcement depth slice. Despite the comparatively lower moisture readings, deeper GPR slice data exhibited numerous elevated reflections and irregular subsurface responses beneath the reinforcement layer. The data displayed significant variability throughout the slab, including localised anomalies consistent with possible voiding, delamination, or heterogeneous slab support conditions. Overall, the deeper radar responses suggest subsurface irregularities not fully reflected within the surface moisture data alone.



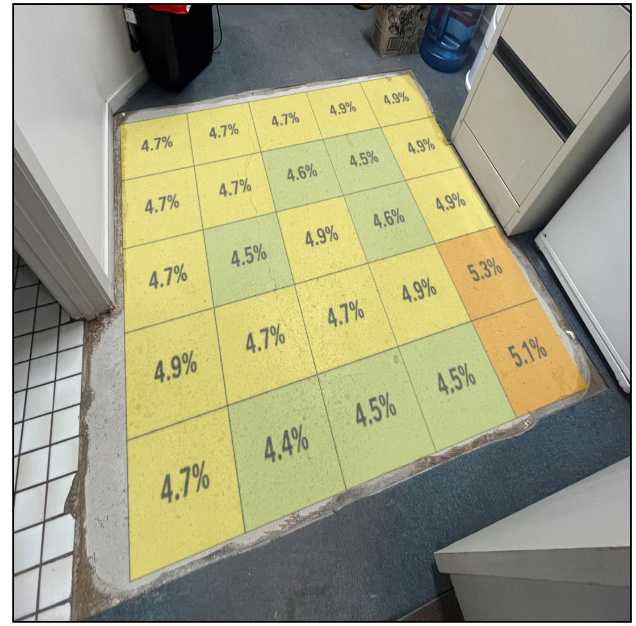
B-scan: Sample GPR profile

Location 6 (Centre Area): Data and Interpretation

Depth slice: 100mm depth (mesh layer)



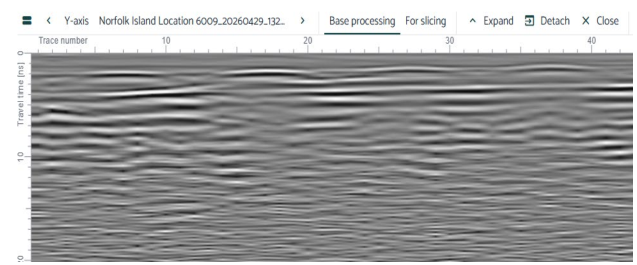
Depth slice: Subsurface layer (200-300mm)



Moisture map

Integrated Data Interpretation

Moisture mapping identified generally moderate and relatively uniform readings across the centre area, with slightly elevated responses toward the right-hand edge. GPR data was collected at tighter 50 mm scan spacings, improving resolution through the slab and reinforcement zone. Depth-slice data identified a prominent longitudinal response corresponding to the large visible crack, located directly below or in close association with the reinforcement layer. The deeper C-scan and B-scan data show inconsistent signal behaviour, disrupted continuity, variable reinforcement cover and spacing, and multiple elevated reflections below the rebar level. These responses are consistent with a non-homogeneous slab system and may indicate localised voiding, delamination, poor consolidation, or irregular slab support beneath the cracked section.



B-scan: Sample GPR profile

Consolidated Investigation Summary

Location	Moisture Severity	Visible Defects	GPR Response Quality	Key Subsurface Indicators	Contributing Mechanisms
Location 1 – Foyer Area	Moderate to High	Diagonal cracking	Moderate	Minor anomaly zones and possible localised voiding	Perimeter moisture ingress and localised slab irregularity
Location 2 – Front Office	Severe	Longitudinal cracking	Poor	Diffuse reflections, disrupted continuity, possible delamination and voiding	Elevated moisture ingress, poor consolidation, slab deterioration
Location 3 – Boardroom	Moderate	Expansion/construction joint, detached skirting	Poor to Moderate	Elevated linear reflections beneath cracked/jointed area	Moisture migration associated with slab joint and heterogeneous slab conditions
Location 4 – North Corner	Moderate to Severe	Significant crack/joint, deteriorated moisture barrier, detached skirting	Poor	Strong irregular reflections and inconsistent deeper anomaly zones	Ongoing perimeter ingress, failed moisture barrier, possible voiding/subgrade variability
Location 5 – East Corner	Moderate	No major visible cracking	Moderate	Numerous elevated deeper reflections and possible localised voiding	Subsurface irregularity, edge beam interaction, localised moisture accumulation
Location 6 – Centre Area	Moderate	Large longitudinal crack (>1 mm)	Poor	Variable reinforcement cover, disrupted continuity, widespread anomaly zones	Non-homogeneous slab conditions, possible voiding/delamination, moisture-related deterioration
Location 7	Moderate	Limited access	Limited	Limited data available	Conditions generally consistent with broader slab behaviour.

Recommendations

Based on the findings of this investigation, South-East Scanning recommends the following:

Drainage Improvements

External drainage conditions around the building should be reviewed and improved to reduce water accumulation along the slab perimeter. Surface grading, runoff management, and perimeter drainage infrastructure should be assessed to minimise ongoing moisture ingress into the slab system.

Targeted Intrusive Investigation

Targeted intrusive investigation is recommended in areas exhibiting the strongest anomalous GPR responses, particularly Locations 2, 4, and 6. This may include:

- Core drilling
- Localised breakout
- Verification of slab thickness and underside condition
- Inspection for voiding, delamination, or subgrade washout

Intrusive verification would provide greater certainty regarding the extent and nature of the identified subsurface irregularities.

Building and Structural Assessment

A suitably qualified structural engineer or building remediation consultant should review the findings of this report in conjunction with the observed cracking, moisture ingress, and slab condition to determine whether remediation or ongoing monitoring is required.

Floor Finish and Moisture Management

Consideration should be given to the removal or temporary lifting of impermeable floor coverings in heavily affected areas to allow further inspection and assessment of slab moisture conditions. Existing finishes may be limiting evaporation and contributing to prolonged moisture retention within the slab.

Ongoing Monitoring

Areas exhibiting active cracking or elevated moisture response should be periodically monitored for further movement, moisture migration, or deterioration.

Potential Remediation Pathways

Subject to intrusive verification confirming that the slab remains structurally serviceable, remediation should focus on reducing further moisture ingress, improving slab durability, and limiting moisture migration through the concrete matrix.

The priority should be correcting external drainage. Any concrete treatment will be limited if surface water continues to accumulate against the building perimeter or migrate beneath the slab. Surface grading, downpipes, stormwater discharge, perimeter drainage, and ponding against the structure should therefore be reviewed and rectified before internal finishes are reinstated.

Where the slab is confirmed to be generally intact, consideration may be given to concrete densification and permeability-reduction systems. Nano-silica-based products, including systems such as E5 Shield and similar products, are designed to penetrate existing concrete, reduce porosity, densify the near-surface matrix, and reduce moisture transmission through the slab. E5 describes Shield as a penetrating treatment for existing slabs that reduces porosity and moisture ingress, while its liquid fly ash/nano-silica admixture systems are promoted to lower permeability in new concrete applications.

For this site, a topical or penetrating remedial treatment may be suitable where the primary issue is capillary moisture movement through a porous or moisture-affected slab, rather than major structural failure. Such treatments may help reduce vapour transmission, improve surface hardness, and prepare the slab for future floor finishes, provided the substrate is properly prepared and the product is compatible with the intended flooring system.

However, densification or moisture-mitigation treatments should not be treated as a substitute for structural repair where voiding, delamination, loss of slab support, or significant cracking is confirmed. Areas exhibiting the strongest GPR anomalies, particularly where cracking and disrupted subsurface responses coincide, should be verified by targeted intrusive investigation before selecting a final remediation method.

If intrusive investigation confirms localised voiding or loss of support, remediation may require localised breakout and reinstatement, pressure grouting, crack repair, joint treatment, or partial slab replacement. If the slab is found to be broadly intact, a combined remediation strategy involving drainage improvement, crack repair, slab drying, concrete densification, and installation of an appropriate moisture-tolerant flooring system may allow the slab to remain in service.

Final product selection and specification should be undertaken by a suitably qualified remediation contractor, materials consultant, or structural engineer who is familiar with concrete moisture mitigation systems and the environmental conditions on Norfolk Island.

South-East Scanning recommends consultation with McClay Industries regarding potential concrete densification and moisture mitigation solutions suitable for the conditions identified during this investigation.

For further information regarding available remediation systems, please contact Reuben Ramsay at reuben@mcclay.au

If you have any queries about this document or its contents, don't hesitate to contact South-East Scanning.

DOCUMENT PREPARED BY

South-East Scanning Pty Ltd
Specialists in Utility Locating, GPR Concrete Scanning & Structural Diagnostics
1 Mitaro Rise, Pacific Pines QLD 4211
T: 1300 175 543
E: info@southeastscanning.com.au
W: www.southeastscanning.com.au

Prepared by: Aidan Waszaj
Operations Manager
aidan@southeastscanning.com.au
T: 0421 193 439
LinkedIn: https://www.linkedin.com/in/aidan-waszaj/

A.B. Waszaj