Biotopia Environmental Assessment Pty Ltd

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Biotopia Environmental Assessment

ENVIRONMENTAL ASSESSMENT REPORT

Biotopia Report ID:	200205-1 [redacted]
Address:	**[redacted] Avonsleigh VIC 3708**
Owner/occupant:	[redacted]
Date of Attendance:	5 February 2020
Date of Report:	11 February 2020

EXECUTIVE SUMMARY

Some mould found, especially the son's bedroom and master bedroom. Also some insect particles. These are associated with various allergic symptoms.

Slab is damp in similar locations.

Noted condensation on many windows has caused mould and some damage to the timber frames/sills, which is typical of a significant amount of moisture entering the house over a wide area, and entirely typical of a damp slab.

Noted moisture some 15-20 cm under the brick paving surface at the 'high' side of the house where there is a significant slope and earth-retaining walls.

Also noted dampness at the far / low side of the house near the laundry, and mineral efflorescence.

It is therefore likely that water is percolating through the soil and under the pavers to then contact the side of the slab at some locations inc. the master bedroom, flowing under the slab all the way to the end of the house and down the slope, wetting parts of the house where there may be some gap or hole in the waterproofing plastic sheet, presumably at the son's bedroom that incorporates a doorway in the windows.

This will take some work to dig a suitable drainage asset to prevent subsoil water flows to the house, then drying the slab.

Some remediation of carpets, contents, curtains and ceilings/walls/surfaces is recommended to physically remove mould and insect contaminated dusts.

INSTRUCTIONS

Prior to assessment of this property, Biotopia was requested to investigate and provide a report on the following / Interpreted thus:

1. Is there a significant mould or moisture ingress problem?

2. If there is a problem, what may be causing it?

3. Suggest a strategy for the remediation of the above issues.

BACKGROUND

From information given verbally by the owner/representative and from initial general visual impressions:

- The structure is an approx. late 1970's – early 1980's free-standing house; single storey; slab floor with carpet, engineered timber coverings and tiles in wet areas; three or so bedrooms; en suite bathroom off master bedroom; main bathroom between the two children's bedrooms; open plan kitchen/dining area; separate lounge room adjacent to kitchen; corrugated metal roof with approx. 30° pitch and wide eaves except at gabled roof ends; skylight and rangehood exhaust penetrations through roof; bathroom exhaust vents via eaves/bargeboards; raked high ceilings in communal areas, level lower ceilings in bedrooms, bathrooms, laundry; large property (hectares) with distinct slope towards and away from the level area where the house is situated and earth-retaining sleeper-type walls approx. 3 m from house with brick paving and simple shallow surface gutters along the 'high' side of the house at earth-retaining walls.
- Occupants included a family of four (two adults, two school-aged children), rabbit and cat.
- The owner/occupant stated to me that they had noticed several respiratory and other allergic symptoms among family members but had not noticed any definite roof leaks, ground flooding, pipe water escape events, but had noticed condensation on many/most windows especially overnight in cooler months, and mould spots on the inner side of window panes, with replacement of several single-pane windows with retrofitted double-glazed units.
- I declare that none of the occupants nor representatives are known to me aside from this sole professional interaction, and that I have no conflicts of interest nor vested interest, and that I have an agreement for the payment of all my professional fees in advance regardless of the outcome of this report. I do not operate nor have financial interests in any remediation or similar cleaning or repair business. I am guided by the published best-practise standards and guidelines for physically testing mould/fungi and moisture. This is therefore a true and accurate report to the best of my knowledge.

OBSERVATIONS

1. MOULD: see Tables	Significant mould detected in places.
2. TEMPERATURE & HUMIDITY	Outside: 22.3°C, 50.5%RH = 10.02 g/m^3; Dew point 11.5°C M'bed room: 24.6°C, 49.6%RH = 11.22 g/m^3. DP 13.4°C Spare room: 20.8°C, 59.2%RH = 10.77 g/m^3. DP 12.6°C Hence somewhat more humid indoors in areas of low airflow/ventilation.
3. MOISTURE by meter	Dampness detected in places, mainly the slab or items in contact with it.
4. SIGNS OF MOISTURE	Evident condensation and other signs.
5. CONTENTS	CONDITION 2 (settled mould-contaminated dusts) likely
6. VENTILATION	Presence of poorly placed exhaust fans in bathrooms, serviceable. No signs of pre-existing mould on bathroom ceilings, however.
7. HEPA-FILTERED AIR FLOW IN CONTAINED AREA >4 chg/hr	N/A
8. AIR FLOW TO SUBFLOOR adequate (≥6000 mm^2/m)	N/A
9. ODOUR	Musty in master bedroom and son's bedroom.
10. THERMOGRAPHY	No thermal significant features consistent with current moisture observed in locations suitable for this type of assessment such as plasterboard walls, ceilings. Possible slight dampness under the A/c unit in the kitchen, but not much.
11. DAMAGE TO STRUCTURE, CONTENTS FROM MOULD, MOISTURE	Various untreated damage seen
12. CHEMICALS AND OTHER HAZARDS	None seen

CONCLUSIONS

1. Is there a significant problem?

There is a significant mould/moisture problem in some sections of this house.

Son's bedroom and the master bedroom are especially damp and mouldy including signs of moisture/condensation on windows via damage to window frames/sills, moisture measurements of the slab especially at the periphery / near windows, noted mineral efflorescence under the carpet especially in the master bedroom. Corrosion / rusting of the metal tacks on the smoothedge/ tackplates and some visible mould.

Noted live / viable moulds consistent with recent (<2 years or so) active mould growth, typically from excessive moisture.

Noted minor insect activity via wing scales. No carpet beetle larval hairs seen, however. Some house dust mite parts seen in roofspace and under the carpet in the master bedroom, as typical of high humidity and mould growth.

Fascinating amount of visible dark-coloured fungi under the eaves on the soffits at the exhaust ports from the bathrooms suggesting frequent condensation and consequent damage.

2. If there is a problem, what may be causing it?

Moisture ingress to the slab at the 'high' side/s of the house, plus near the window of Jack's bedroom on the 'low' side overlooking a reasonable slope away. Wide eaves around most parts of the house makes direct rain contact with walls an unlikely source of moisture.

This has caused mould, rot and insect activity in the damp materials (primary sites) such as under/within carpets and underlay.

This has also caused biological activity and water damage at secondary sites of condensation such as single-glazed window panes / frames, and the soffits where damp air from the bathrooms is exhausted. It is likely there is biological activity within these exhaust ducts based on experience. Ideally such ducts would be larger diameter and well insulated to prevent condensation, and ideally run for longer to aid drying them out. Replacement is typically cheaper, easier and more effective than cleaning. Installation of a separate set of fans over each shower would also be of benefit, especially if they were somehow wired to run for a set time after use of the shower, and ideally turning on when greater humidity than outdoors is detected. These used to be available at Bunnings some years ago, but not seen recently.

Noted significant dampness in the soil some 15-20 cm or so under the brick pavers, seemingly under a membrane given the slight resistance offered when the soil moisture meter was inserted in a small number of locations.

It is likely the high-rainfall area and long, significant slope towards the house have contributed to significant surface and more importantly, subsoil water flows that are not adequately intercepted at the earth-retaining walls at the brick paved areas nor the shallow concrete gutters, traveling under the brick pavers and putative plastic membrane towards the house, contacting the sides of the slab at the master bedroom near/at the window, penetrating into it.

It was also noted there was dampness in the slab at the son's bedroom window, likely the cause of significant mould found in the room. This was curious as it was some distance from the high-side of the house and side window / master bedroom.

It was further noted there was dampness under the slab / at the bricks to the side of the house at the furthest corner from the high side, near the laundry.

It is therefore possible that moisture is flowing entirely under the house but only penetrating whatever waterproofing plastic sheeting there is at a few sites, presumably where there are holes or inadequate sealing / overlapping of adjacent sheets, and/or where plastic at the side of the slab has been damaged/removed or such. This is not unusual.

An engineer or other professional with experience in hydrogeology and civil engineering / drainage should be consulted specifically regarding the design and installation of drainage assets to prevent surface and subsoil moisture flows from reaching the house. In my most humble non-engineer opinion, the installation of a French trench drain around the high-sides of the house may be of great benefit. These drains are typically cut/dug perhaps 1 m deep via a 'Ditch Witch' or similar earthmoving machine, and perhaps 200 mm wide, lined with geo-tex or similar non-degrading mesh to keep the soil at bay, then a slotted pipe of suitable strength and diameter to accommodate the weight/pressure of WET soil above and laterally (often the cause of pipes being crushed). Ideally the slots are placed facing down to better drain water that otherwise pools until it rises above the height of upwards-facing slots. A suitable gradient to similar facilitate free drainage and removal of debris, silt, etc., is

also advisable. The trench is then filled with 1-2 cm rocks or pebbles to allow the free movement of water straight down, and not 'bridge' through the soil that came out of the trench in the first place, which may lead to disappointment. Usually the geo-tex is folded over the top of the pebbles, and in many instances decorative pebbles or a grate is placed over the top, sometimes even a layer of turf, but this tends to dry out.

Installation of 'whirly bird' roof vents or similar may be good. These may improve energy efficiency and comfort, and limit potential condensation in general.

3. Suggested strategy for remediation of above issues based on Results.

A brief, suggested basic outline to assist the safe remediation of the property of mould and moisture as per IICRC s500 / s520 standards by a qualified practitioner, and additional builders as appropriate, may include the points below, but must be negotiated between all materially interested parties.

3.1. Strict containment protocols as per standard, including: warning signs (ideally with date and contact name/mobile phone number); appropriate PPE with documentation of respirator filters being in-date; keeping health and site access/visitor logs; prohibition of any non-remediation personnel entering during remediation works; use of multiple containment cells via sealed plastic sheets, zip-doors, air pressurisation / flow balancing, HEPA filtration, etc.

3.2. In this instance: ALL AREAS OF HOUSE AND ROOFSPACE. Also soffits/eaves outside bathrooms.

3.3. Identify and repair the source/s of moisture ingress if not already so done. See Section 2 regarding French trench drains.

3.4. Record / remove / remediate / wrap (or discard) all contents items including clothing, window coverings, bedding, carpets, toiletries/cosmetics, cookware, food items, pictures/paintings, cabinets, etc., and store in a clean, safe, dry, temperature controlled location ideally verified mould-free.

3.5. Seal up HVAC ductwork, vents, louvers, registers, electrical appliances (ovens, fans, etc.), fixtures/fittings (inc. lights, power-points, switches, ports, conduits), and/or remove them. Definitely remove the narrow-bore ducts from the bathroom exhaust fans (to be replaced with insulated larger new ones later).

3.6. Master bedroom wall around window / Son's bedroom around window: remove skirting boards and plasterboard wall panels from floor to ceiling and remediate surfaces. Discard any fibrous insulation. Check any membranes on both sides for staining/damage/possible growth/signs of condensation

Note: humid air rises up within the wall cavities and thus mould often grows high within the cavity, but is usually not visible as normal for most moulds.

3.7. Replace rotten baseplates, bases of studs within cavities, cleaning/remediating underneath each. Seek advice from a suitable engineer/builder re. structural load-bearing elements.

3.8. Clean, remediate, scrub, HEPA vacuum, wet-wash, mop, etc., all exposed surfaces including ceilings, walls, pelmets, windowsills, doors, floors AND all remediation equipment (dehums, air movers, HEPA units, etc.) Do not forget to clean within the skylight in the kitchen.

3.9. Continue to dry the slab, baseplates, bottoms of studs, etc., completely

Note: watch for the two-phase drying profile and long 'tail-end' of drying typical of masonry, thick timbers. Air movement and many dehums helps 'wet' phase, but only heat helps 'damp' phase, and fewer dehums / air-movers are required. Monitor the air temp and humidity. THIS WILL TAKE A LONG TIME, LIKE MAYBE 6 WEEKS AND WILL BE DIFFICULT TO MONITOR WITHOUT DRILLING AND INSERTING HUMIDITY SENSORS INTO THE SLAB.

3.10. After 48-72 hrs, repeat micro-detail clean, then allow at least 24 hrs before clearance sampling by IEP

3.11. Have an independent IEP collect samples and perform a ***post-remediation verification*** (PRV) get a valid **PRV certificate** (as per IICRC s520 sections 12.2.1, 12.2.2, 15, 16; s500, 12.5.9, etc.) Do not attempt to collect samples or perform PRV yourself as this could be deemed a 'conflict of interest.'

3.12. Only after receipt of the valid PRV certificate should containment be taken down and site control formally passed to the Builder for rebuilding works.

OTHER NOTES

Methods used in the preparation of this report may have included but is not limited to, and in accordance with common practice in monitoring environmental surfaces in industry:

- Use of 'sterile technique', disinfection of hands, equipment before and after use, and due diligence to avoid cross-contamination. 400-hole plate was cleaned by warm ultrasonic bath in RO water with detergent every two weeks, and cleaned onsite with single-use alcohol-based lens cleaning wipes to avoid residue build-up.

- Viable surface samples: Sterile cotton fibre tipped swabs, 10 cm^2 area, immediately inoculated onto agar media onsite. For transport or storage prior to inoculation, dry sterile cotton tipped swabs in their own sterile tubes were used dry and kept dry and cool (or no more than room temperature) and away from radiant heat / light.

- Total surface samples: Where possible, as per ASTM D7658-17. Zefon 'Bio-Tape.' Total sample area 25.4 mm x 16 mm = 4.1 cm^2. Total counted area at 400x was **0.119 cm^2** (approx. 3% of total sample area), by 'no-overlap' method (63 discrete non-overlapping adjacent FoV, being 31.5 FoV/row x 2 rows; rows were typically separated by some distance and not adjacent) hence raw numbers of particles counted from inner red lines on Bio-Tape were converted to 'per cm^2' by **x8.42**

- Viable airborne fungal particles: A calibrated SKC 'QuickTake30' unit with an Andersen single-stage 400-hole impactor at 30 L/min, 5 min hence 150 L of air (= 0.15 m^3). Calculation of raw-count viable airborne fungal numbers were (via pre-prepared lookup table) pre-factored for use of plastic Petri dishes (1.25x). as per Andersen, J Bacteriol. 1958 November; 76(5): 471–484, then Andersen Table 1 was applied, then expressed as 'per m^3' by **/0.15** and rounding to nearest integer.

- Total airborne particle sample collection as per ASTM D7788-14: A calibrated SKC 'QuickTake30' unit at 30 L/min, 5 min hence 150 L of air (= 0.15 m^3), and a fresh Zefon 'Air-O-Cell' cassette unit that was then re-sealed. Analysis as per ASTM D7391-17: examined microscopically at 400x, counting 100% of the sample as per 12.3.8.1c, and thus converting from raw numbers per sample to 'per m^3' by **/0.15**

- Agar media: "SabGC" agar media in plastic Petri dishes were used and cultured for 3 days at 27°C with periodic examination and photography if practicable. Raw counts were converted from 10 cm^2 sampled to 100 cm^2 by **x10**

- Microscopy: Radical RXLr-3 at 40x/100x/400x/1000x with Lacto-Glycerol Methylene blue / proprietary epifluorescence, and/or phase-contrast, bright-field, oil-immersion, Gram-stain techniques as required. Calibrated periodically (**490** μm diameter FoV at 400x). Images shown are not the complete FoV for technical limitation reasons, and are used for illustrative/confirmation purposes rather than exhaustive.

- Thermography: Testo 875-2 thermographic camera with SuperResolution module active.

- Moisture, temperature, humidity: Testo 606-2 two-prong moisture/humidity meter.

- References include: CDC, USA guidelines (2003); US ACOEM 2002; Australian NHMRC EH32, others; Aust. EPA guidelines; WHO Guidelines for IAQ – Dampness and Mould, 2009, ISBN 978 92 890 4168 3; Australian Standards, Building code of Australia, ISO and other relevant recognised guidelines wherever possible including ASTM D7391-17, D7788-14, D7789-12, D7440-08, D7338-14, D7910-14, D7658-17, and peer-reviewed publications in scientific journals. See http://www.biotopia.com.au

N.B.: Mould will only grow in response to moisture on a suitable food source, producing a great number of live / viable spores. These spores can then spread like dust in small air currents and movement of people and contaminated items, being viable for a number of months but not growing unless a suitable damp food source is settled upon. People can inhale these spores and other mould-associated particles and become increasingly allergic over time, especially if the spores are viable and the person is susceptible to allergies. If a person is significantly immunocompromised or otherwise unwell, there is a risk of infection by some types of moulds that may or may not be present in any particular house. Other organisms such as house dust-mites, however, may also grow to significant numbers and elicit significant allergies under similar conditions.

Yours faithfully,

Dr Wesley D. Black

BSc (Melb), Grad Dip Biotech (Melb), Grad Dip Ed (RMIT), PhD (Melb),
Member of the Australian Society of Building Consultants (ASBC), Australian Society for Microbiology (MASM), Building Dispute Practitioners' Society (BDPS), Metrology Society of Australia (MSA), Australian Mycology Society (AMS), International Society of Indoor Air Quality and Climate (ISIAQ), Indoor Air Quality Association, Australia (IAQAA, Secretary 2019).

Dr Black is proficient in environmental assessments and is a qualified, recognised microbiologist with a PhD in that field. This report is intended to be used in conjunction with civil engineering consultant and other building professional reports as deemed suitable by the insurer and legal bodies.

Biotopia maintains the integrity of its reports but cannot be held responsible for inaccuracies or omissions due to inability to access all areas at the time of assessment, or subsequent actions by other parties that may have interfered with physical parameters, such as the opening up of formerly inaccessible enclosed areas that were damp, mouldy, rotten, or otherwise contaminated. Without prejudice.

APPENDIX 1 - TABLES

1) VIABLE Airborne and Surface fungal counts by culture

Location	**Colony Forming Units (CFU)**		**Identified fungi** (by coverage; adapted from ASTM D7658-17, D7391-17)											
			1. Alternaria \ 11. Ulocladium	2. ascomycete (undiff.)	3. Aspergillus	3. Penicillium	4. basidiomycete (undiff.)	6. Cladosporium	7. Curvularia	X. Trichoderma	X. Chrysonilia	X.Plant. phyllo/Phoma	X: yeasts,	X.Zygomycetes Rhyz/Muc.
AIRBORNE AV	**/samp-le**	**/m³**												
01 Control: outdoors, upwind prior to entry	14	127	1			2		1						
02 entry / living/kitchen	5	40	1			1								
03 master bedroom	26	233	2	2		1		1				2		
04 Daughter's room	32	280	1	2		1		1				1	1	
05 Jack's room	140*	1240	4*	3		2		2				4*	1	
SURFACE SV	**/samp-le**	**/100 cm²**												
01 'fridge	45*	450	3		3* nig	2*								
02 master bedroom under carpet sg	1	10	1											
03 roofspace	21*	210	3	1	2* nig							1		
04 Son's room, shelf	36	360	2	1	2 nig	2		2				3	1	
05 living room wall cavity sg	1	10												3
06 outside under eaves at exhaust for en suite bathroom fan	>400 ****	> 4000 ****				5 ****		1						

NOTE: Not useful for detection of some moulds such as Chaetomium and Stachybotrys; "by coverage" as adapted from ASTM standards D7658-17, D7391-17 and is not to be confused with 'numbers of colony forming units (CFU).'

2) TOTAL Airborne and Surface fungal counts by direct microscopy

Location	Sum fungal structures		Identified particles (by coverage; ASTM D7658-17, D7391-17)												
			1. Alternaria / 11. Ulocladium	2. ascospores (undiff.)	3. Pen. / Asp 6. Clado	4. basisio (undiff)	5. Chaetomium	8. Drech. Bip. 7. Curv.	9. smut Myxo Periconia	10. Stachybotrys	Pollen	Mineral grit	Vegetable fibre, wood, textile	Hair, fur, dander	Other comments
AIRBORNE AT	**/sample**	**/m³**													
01 Control: outdoors, upwind prior to entry	86	573	2	2	2	1		2	1	1	3	1	1	1	
02 entry living/kitchen	104	693	2	3	3	1					1	1	2	2	
03 master bedroom	189*	1260	3*	3	3*	1					1	2	3	4	
SURFACE ST	**/sample**	**/cm²**													
01 m'bed under carpet	>150 *	1263	3*	3* Stemphy	2*							4	5	4	3IS *1
02 roofspace	82*	690	1	1	3*	1			1		2	3	3	1	3IS *1
03 wall cav between living and master bedroom via power point	61	514		2	2							4	4	2	
04 soffit at bathroom exhaust, visible spot	>> 750 ****	> 5000		5 ****	3 ***	?		3*					3		

*1: carbonate mineral salts given bubbles on addition of lactic acid-containing dye.

KEY Table 1 – VIABLE AIRBORNE FUNGAL PARTICLE COUNT relative to Outdoor Air Abundance (OA) and (generally recognised numbers and conditions)

Rating	CFU/m³	Load category *1	Comments
Not Detected		0	May indicate lack of growth on media, lack of detection cf. actual absence
(Low)		1	Only practically possible with HEPA filtration, >7 air-changes/hr and positive pressure
Normal	<OA (<500)	2	Slightly less than outdoor air, with range of organisms, no dominant species
Elevated	≤2OA (≤1000)	3	Esp. if a species is dominant, or small numbers of species of similar xerophelicity. Check spore viability and materials moisture. Respirators recommended in addition to appropriate PPE if airborne over a substantial area. A preponderance of similar spores, thus of an aberrant ecology but normal or low number may be considered 'Elevated'
High	>2OA (>1000)	4	As above. The source of mould and moisture should be identified and addressed. Containment and full PPE recommended if airborne over a substantial area. Clean tools, equipment, exposed items when leaving site. A preponderance of similar spores, thus of an aberrant ecology but 'Elevated' number may be considered 'High'
Very High	>2OA (>5000) (+AE)	5	As above. If airborne over a substantial area, remove occupants and workers without PPE, especially with predisposing respiratory and/or immunocompromisory conditions, chemotherapy, asthma, severe allergies, etc. Monitor for infection with known pathogenic species such as *Aspergillus fumigatus*. Log eye, nose, throat, lung, skin conditions and seek medical attention as appropriate. A preponderance of similar spores, thus of an aberrant ecology but 'High' number may be considered 'Very High'

AE = Aberrant Ecology score from 0 AE – 5 AE, being a preponderance of similar spores, especially if likely to be clonal, and/or different types of organisms of similar water-activity (Aw) requirements, and thus likely to be from the same active growth area *en masse.* A normal ecology has a range of various organisms in relatively balanced numbers, whereas an aberrant ecology may have a reduced range of organisms with one or more 'dominant' mould types, which may be 'moisture loving' (high Aw requirements) and/or prefers consuming other moulds (e.g., Trichoderma), and/or potentially infectious and/or mycotoxogenic. Noted aberrant ecology may be deemed a higher designation.

OA = Outdoor Abundance / Air control/s;

Adapted from and/or as per Kemp & Neumeister-Kemp, "The Mould Worker's Handbook" (2010, 2nd ed.) and "The Australian Mould Guide" (2010, 2nd ed.) With acknowledgement of the lack of conclusively established and widely / formally recognised limits linked to health effects.

*1: As adapted from ASTM 7658-17 and D7391-17 (total count) as a general representation of relative abundance / surface area coverage. ASTM does not appear to have a standard for laboratory analysis of viable air or surface fungi.

"s" : spot sample, primarily to ID an organism in a restricted area or visible patch, not indicative of the general area.
"g" : general sample, likely indicative of the general environment / broad area / room.
"sg": indicative of a restricted area, e.g., under carpet, in cupboard.

KEY Table 2 – TOTAL AIRBORNE PARTICLE COUNT, relative to Outdoor Abundance (OA) and (generally recognised numbers)

Rating	TC /m^3	Load category *1	Comments
Not Detected		0	May indicate lack of detection cf. actual absence
Low	<*OA/2* (<100)	1	Only practically possible with HEPA filtration, >7 air-changes/hr and positive pressure
Normal	<OA (<500)	2	Slightly less than outdoor air, with range of organisms, no dominant species / no aberrant ecology evident
Elevated	≤2OA (≤1000)	3	Esp. if a species is dominant, or small numbers of species of similar xerophelicity. Check spore viability and materials moisture. Respirators recommended in addition to appropriate PPE if airborne over a substantial area.
High	>2OA (>1000)	4	As above. The source of mould and moisture should be identified and addressed. Containment and full PPE recommended if airborne over a substantial area. Clean tools, equipment, exposed items when leaving site.
Very High	>2OA (>5000) (+High AE)	5	As above. If airborne over a substantial area, remove occupants and workers without PPE, especially with predisposing respiratory and/or immunocompromisory conditions, chemotherapy, asthma, severe allergies, etc. Monitor for infection with known pathogenic species such as *Aspergillus fumigatus*. Log eye, nose, throat, lung, skin conditions and seek medical attention as appropriate

TC = Total Count via microscopy; all identifiable fungal structures including spores, hyphae, conidiophores. Chains or clusters of small spores (Penicillium, Aspergillus, etc.), and/or aberrant numbers of large heavy spores (Chaetomium, Stachybotrys, etc.) shall be regarded as indication of nearby active growth

AE = Aberrant Ecology score from 0 AE – 5 AE, being a preponderance of similar spores, especially if likely to be clonal, and/or different types of organisms of similar water-activity (Aw) requirements, and thus likely to be from the same active growth area *en masse.* A normal ecology has a range of various organisms in relatively balanced numbers, whereas an aberrant ecology may have a reduced range of organisms with one or more 'dominant' mould types, which may be 'moisture loving' (high Aw requirements) and/or prefers consuming other moulds (e.g., Trichoderma), and/or potentially infectious and/or mycotoxogenic.

OA = Outdoor Air control/s;

DS = Dust Score from 0 DS – 5 DS; particles including pollen, textile and mineral insulation fibres, dander, skin, grit (non-fungal, non-insect)

IS = Insect Score from 0 IS – 5 IS; particles including wings, wing-scales, body parts, hairs, carpet beetle larval hairs (non-fungal, non-dust)

*1: ASTM 7658-17 12.2.10.1 Fungal Loading Categories and 12.2.10.2 Non-Fungal Particle Loading Categories, each being 0 – 5.

Category designations are subject to interpretation with reference to the control sample/s and other observations of aberrant ecology, mould types, surface area coverage. Noted aberrant ecology may be deemed a higher designation.

Adapted from and/or as per Kemp & Neumeister-Kemp, "The Mould Worker's Handbook" (2010, 2nd ed.) and "The Australian Mould Guide" (2010, 2nd ed.) at 15 L/min. It is understood that in general 28.3 L/min is slightly more efficient at oil droplet capture but variously efficient for some species of fungi due to bounce-off [Trunov M, et al., 2001], but likely far less effect than general uncertainty, random variation due to small bursts of particles from occupant/assessor activity, breezes, etc., but more precise due to greater air volume sampled. With acknowledgement of the lack of conclusively established and widely / formally recognised limits linked to health effects.

*1: ASTM 7658-17 12.2.10.1 Fungal Loading Categories and 12.2.10.2 Non-Fungal Particle Loading Categories 0, 1, 2, 3, 4, 5, respectively. Category designations are subject to interpretation with reference to the control sample/s and other observations of aberrant ecology, mould types, surface area coverage

"s" : spot sample, primarily to ID an organism in a restricted area or visible patch, not indicative of the general area.
"g" : general sample, likely indicative of the general environment / broad area / room.
"sg": indicative of a restricted area, e.g., under carpet, in cupboard.
'Other Spores": includes undifferentiated Ascospores, Basidiospores, Curvularia, Myxomycetes, Periconia, similar looking smuts, Memnoniella as per ASTM D7658-17

KEY Table 3 – VIABLE SURFACE FUNGAL COUNTS; 10 cm^2 area via swab on 90 mm diameter Petri dish

Rating	CFU/100 cm^2 *2	Load category *1	Comments
(Not Detected)		0	May indicate lack of growth on media, lack of detection cf. actual absence
Low	<100	1	Surface may have recently been wiped or washed
Normal	<500	2	Typically with a range of common outdoor organisms, no dominant species / aberrant ecology
Elevated	<1000	3	Respirators recommended in addition to appropriate PPE. Avoid stirring dusts up including use of HEPA air movers. Ideally use wet-washing techniques. A preponderance of similar spores, thus of an aberrant ecology but normal or low number may be considered 'Elevated'
High	<2500	4	As above. Containment and full PPE recommended if over a substantial area. Clean all tools, equipment, exposed items, skin when leaving site. A preponderance of similar spores, thus of an aberrant ecology but 'Elevated' number may be considered 'High'
Very High	≥2500	5	As above. If airborne over a substantial area, remove occupants and workers without PPE, especially with predisposing respiratory and/or immunocompromisory conditions, chemotherapy, asthma, severe allergies, etc. Monitor for infection with known pathogenic species such as *Aspergillus fumigatus*. Log eye, nose, throat, lung, skin conditions and seek medical attention as appropriate. A preponderance of similar spores, thus of an aberrant ecology but 'High' number may be considered 'Very High'

CFU = Colony Forming Units via culture

AE = Aberrant Ecology score from 0 AE – 5 AE, being a preponderance of similar spores, especially if likely to be clonal, and/or different types of organisms of similar water-activity (Aw) requirements, and thus likely to be from the same active growth area *en masse.* A normal ecology has a range of various organisms in relatively balanced numbers, whereas an aberrant ecology may have a reduced range of organisms with one or more 'dominant' mould types, which may be 'moisture loving' (high Aw requirements) and/or prefers consuming other moulds (e.g., Trichoderma), and/or potentially infectious and/or mycotoxogenic. Noted aberrant ecology may be deemed a higher designation.

*1: As adapted from ASTM 7658-17 and D7391-17 as a general representation of relative abundance. Category designations are subject to interpretation with reference to the control sample/s and other observations of aberrant ecology, mould types, surface area coverage. ASTM does not appear to have a standard for analysis of viable air or surface fungi.

*2: Adapted from and/or as per Kemp & Neumeister-Kemp, "The Mould Worker's Handbook" (2010, 2nd ed.) and "The Australian Mould Guide" (2010, 2nd ed.) with acknowledgement of the lack of conclusively established and widely / formally recognised limits linked to health effects. Further adaptation of swab methods by Dr WD Black based on development and validation studies (in preparation for publication) and ATSM D7789-12.

KEY Table 4 – TOTAL SURFACE PARTICLE COUNT by lift-tape and direct microscopy

Rating	TC /cm²	Load category *1	Comments
Not Detected		0	May indicate lack of detection cf. actual absence
Low	<50	1	Surface may have recently been wiped or washed, especially if DS is low
Normal	<500 (≥3DS)	2	Typically with a range of common outdoor organisms; not aberrant ecology, especially if DS is high
Elevated	≤1000	3	Esp. if . Check spore viability and materials moisture. Respirators recommended in addition to appropriate PPE if present over a substantial area.
Contaminated	>1000	4	As above. The source of mould and moisture should be identified and addressed. Containment and full PPE recommended if present over a substantial area. Clean all tools, equipment, exposed items and skin when leaving site.
Extremely High	>5000 (especially >3AE <3DS)	5	As above. If airborne over a substantial area, remove occupants and workers without PPE, especially with predisposing respiratory and/or immunocompromisory conditions, chemotherapy, asthma, severe allergies, etc. Monitor for infection with known pathogenic species such as *Aspergillus fumigatus*. Log eye, nose, throat, lung, skin conditions and seek medical attention as appropriate

TC = Total Count via microscopy; all identifiable fungal structures including spores, hyphae, conidiophores. Chains or clusters of small spores (Penicillium, Aspergillus, etc.), and/or aberrant numbers of large heavy spores (Chaetomium, Stachybotrys, etc.) shall be regarded as indication of nearby active growth

AE = Aberrant Ecology score from 0 AE – 5 AE, being a preponderance of similar spores, especially if likely to be clonal, and/or different types of organisms of similar water-activity (Aw) requirements, and thus likely to be from the same active growth area *en masse.* A normal ecology has a range of various organisms in relatively balanced numbers, whereas an aberrant ecology may have a reduced range of organisms with one or more 'dominant' mould types, which may be 'moisture loving' (high Aw requirements) and/or prefers consuming other moulds (e.g., Trichoderma), and/or potentially infectious and/or mycotoxogenic. Noted aberrant ecology may be deemed a higher designation.

OA = Outdoor Air control/s;

DS = Dust Score from 0 DS – 5 DS; particles including pollen, textile and mineral insulation fibres, dander, skin, grit (non-fungal, non-insect)

IS = Insect Score from 0 IS – 5 IS; particles including wings, wing-scales, body parts, hairs, carpet beetle larval hairs (non-fungal, non-dust)

Adapted from and/or as per Kemp & Neumeister-Kemp, "The Mould Worker's Handbook" (2010, 2nd ed.) and "The Australian Mould Guide" (2010, 2nd ed.) with acknowledgement of the lack of conclusively established and widely / formally recognised limits linked to health effects.

*1: ASTM 7658-17 12.2.10.1 Fungal Loading Categories and 12.2.10.2 Non-Fungal Particle Loading Categories, each being 0 – 5.

Category designations are subject to interpretation with reference to the control sample/s and other observations of aberrant ecology, mould types, surface area coverage

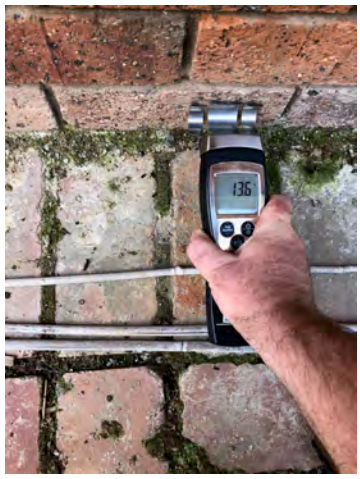
APPENDIX 2 – IMAGES

1. The house from the 'high' side / driveway.

2. The noted slope towards the house, with earth-retaining wall. This may or may not have drainage assets, but it is unclear where they flow, or if they are still intact / not crushed. Noted flex aggie pipe under the decking (not visible, behind/left of image) is not encouraging.

3. The kitchen rangehood vent and kitchen skylight: it was difficult to see if the corrugated metal 'upward' of the rangehood vent is correctly inserted under the roof metal itself (forming an overlap water falls over) or is instead merely stuck on top of it, which tends to lead to disappointment. It is also unclear if the vent is indeed flashed correctly, or if the different colouration is in fact silicone / caulking. Similar comments are made about the stink-pole (not visible), but the rubber boot seems OK at the moment: it is highly encouraged all such roof assets be inspected periodically for weathering, degradation, splitting, etc., and repaired/replaced accordingly.

4. The noted dampness and mineral salt efflorescence at the low-side of the house near the laundry (right). “Dry” is typically 2%MC or less.



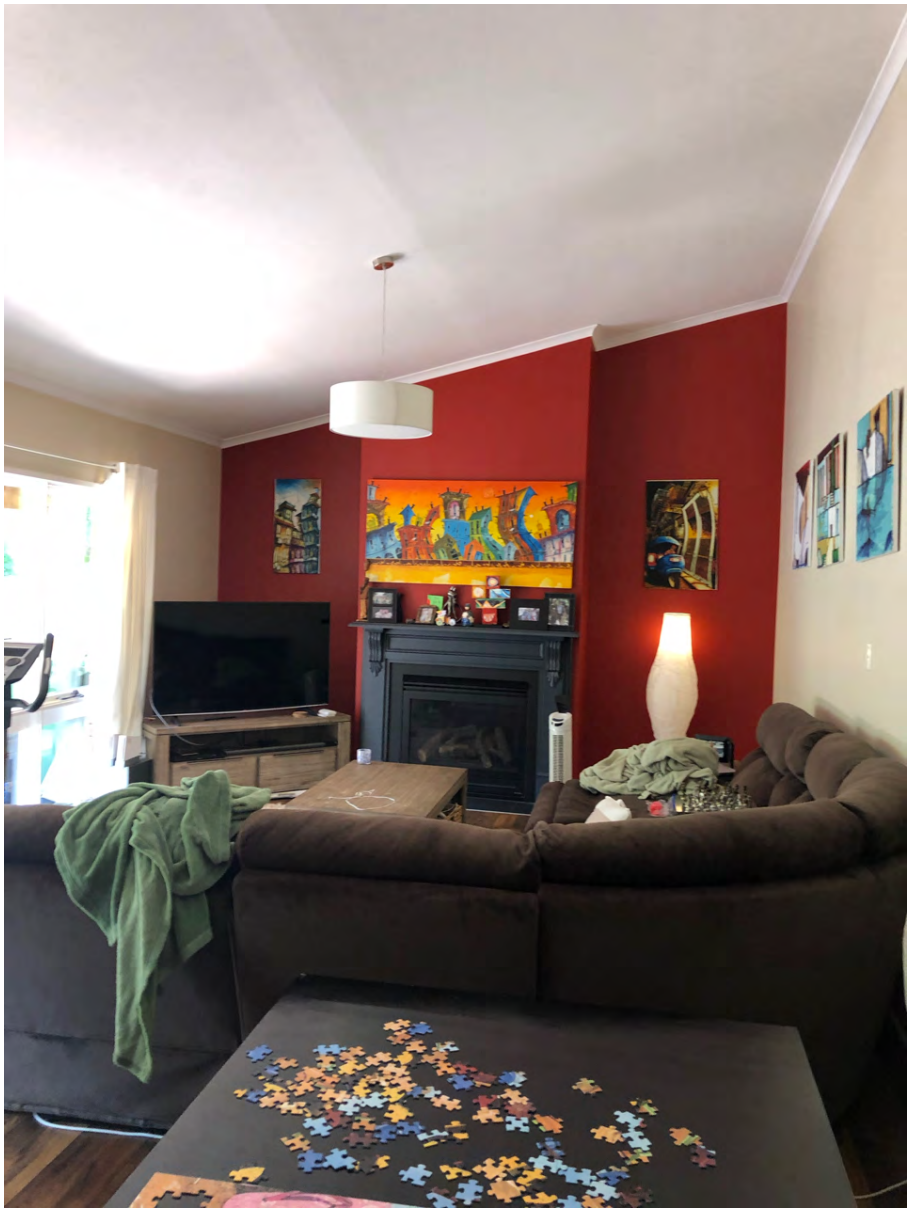
5. The noted mould on the soffits at the master bedroom en suite bathroom fan exhaust.

6. The master bedroom window surround: damp low down.

7. The daughter's bedroom with notable Cladosporium mould spots on the panes. And hissy-kitty.

8. The well-appointed kitchen and meals area. Owner said no water was ever noted leaking from skylight or rangehood. Did note mould within the skylight shaft, however, which may be consistent with condensation rather than a leak. Difficult to read moisture in the slab through the thick timber engineered floor coverings.

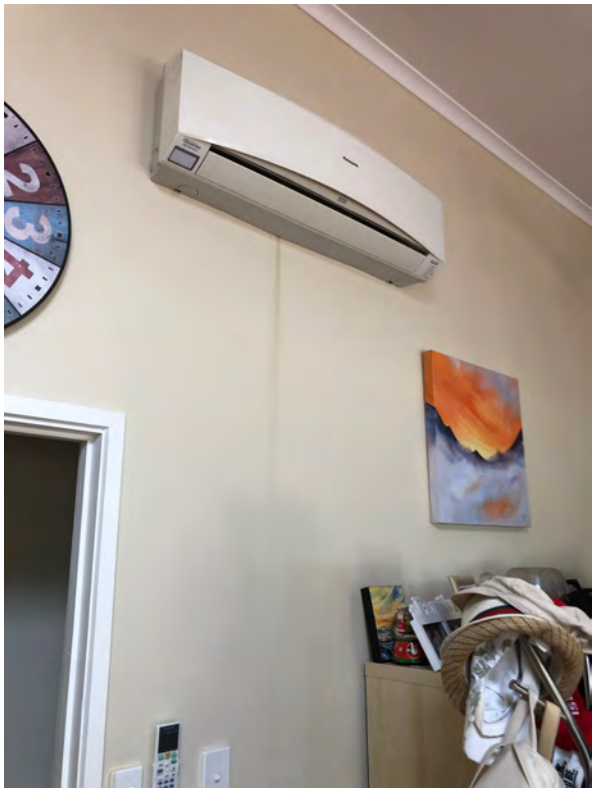
9. The living area.



10. The soil at the high-side of the house: noted difference in dampness between approx. 10-15 cm (dry) and 15-20 cm (wet), below a possible plastic membrane or similar.

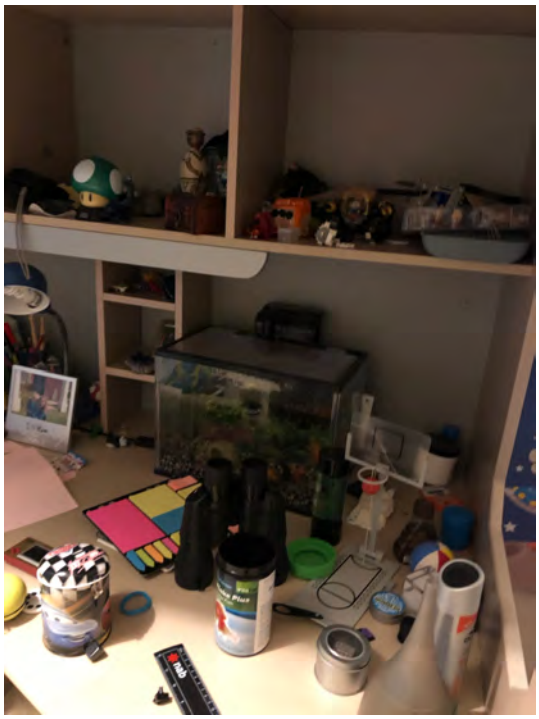
11. The ‘spare’ bedroom.

12. The kitchen A/C did have water staining below it. Possibly a blockage of the quite long condensate pipe that runs all the way to the eaves. Does happen, requiring an occasional flush-out.

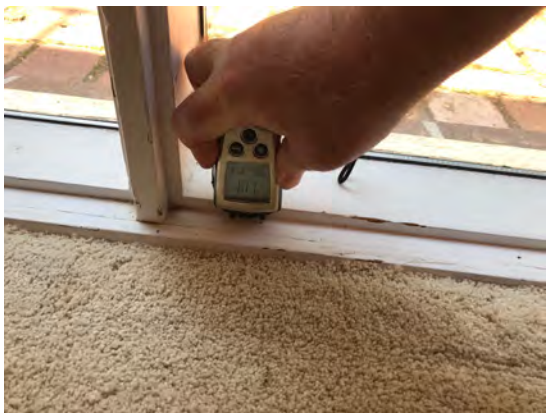


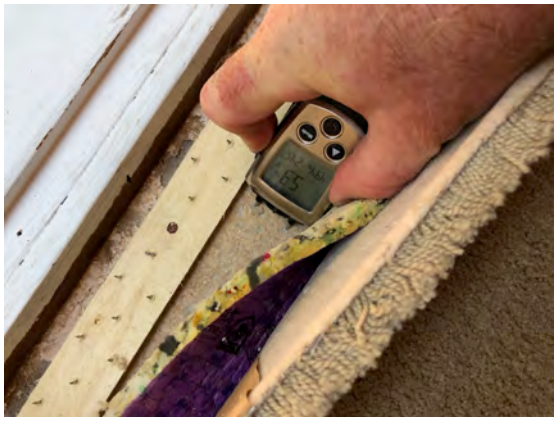
13. The daughter's bedroom.

14. The son's bedroom. Dampness detected at the door/window frame threshold.

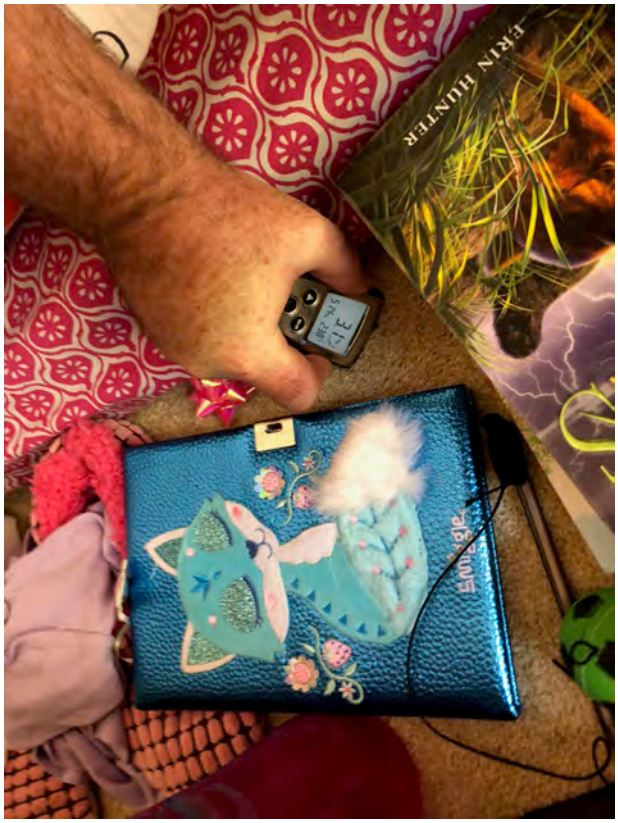


15. The master bedroom windowsill. Significant dampness in the slab.

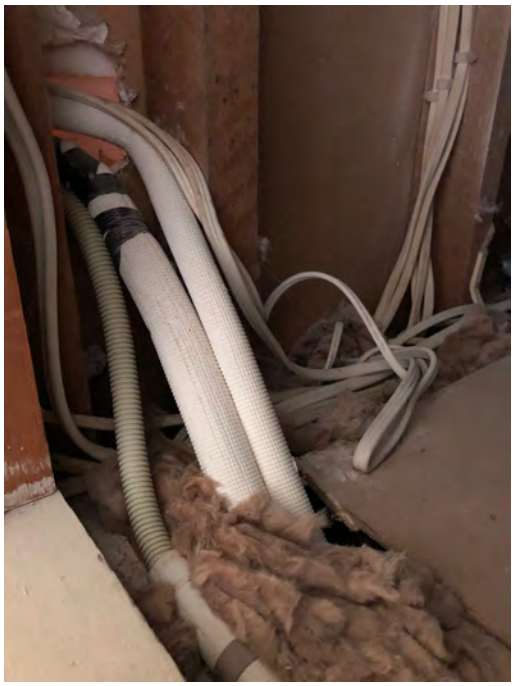




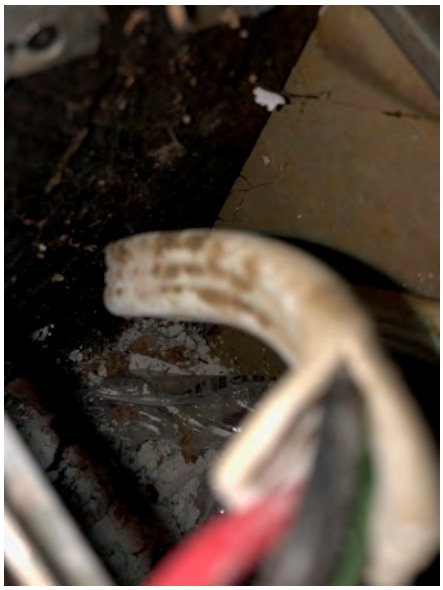
16. The master bedroom slab under the daughter's temporary bed was quite damp.



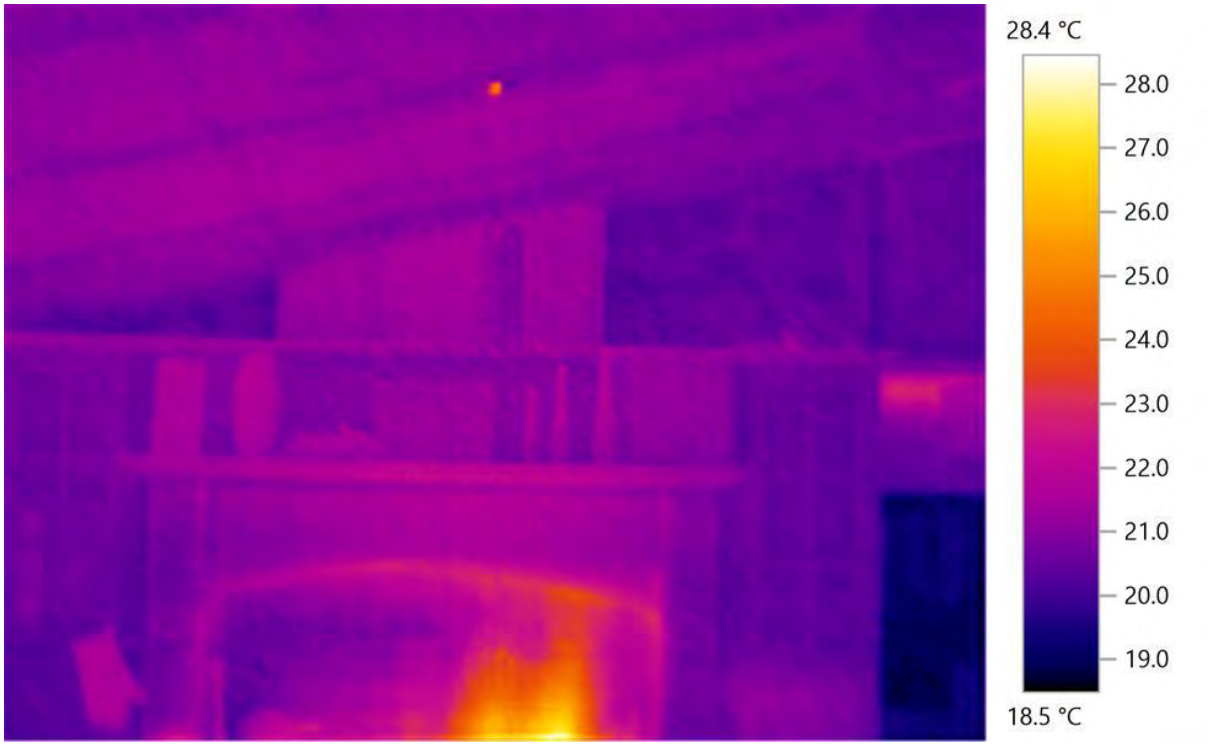
17. The roofspace. Noted anticon reflective blanket under metal roof. Unclear if water ingress into the fibrous insulation above it. Generally seems pretty dry here, but would benefit from 'whirlybirds' to assist removal of significant moisture rising up from the damp slab.

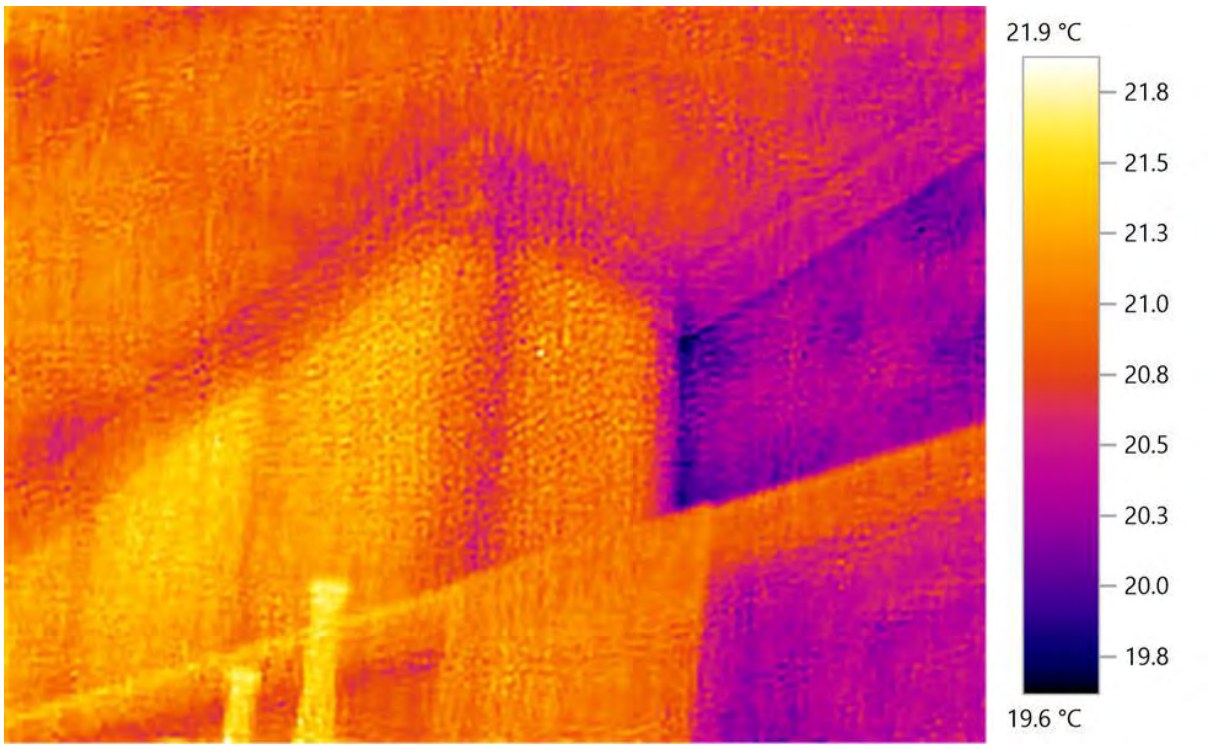


18. The power point in the living room next to the fireplace, facing into the wall to the master bedroom. This was the closest access point to the noted moisture in the master bedroom wall near / under the window.

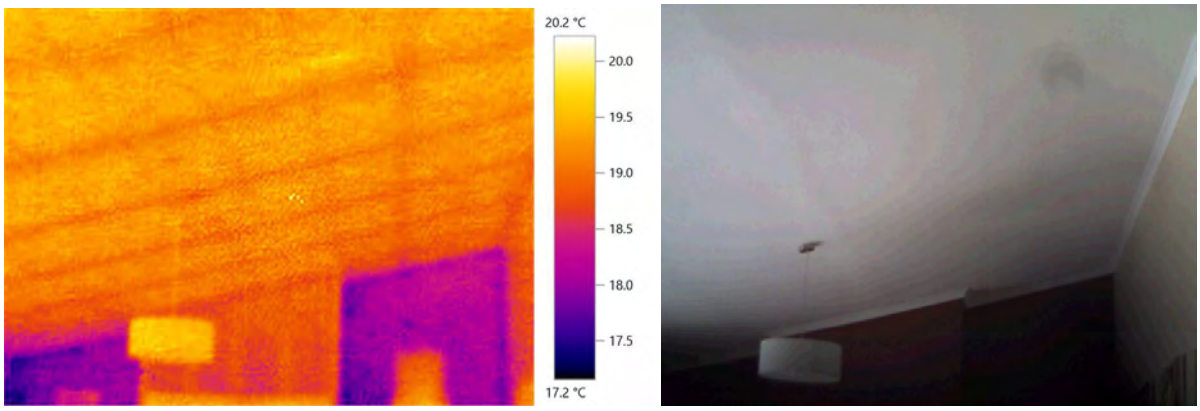


19. Thermography of kitchen.

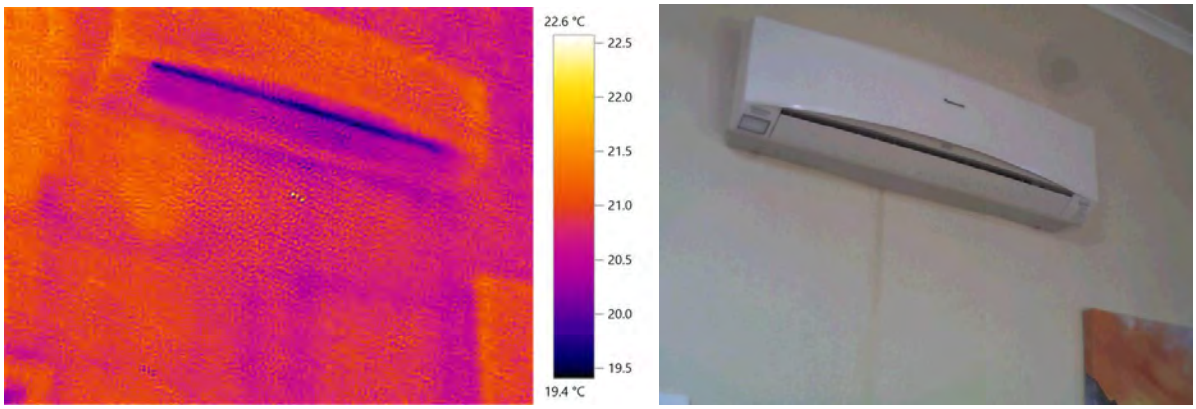


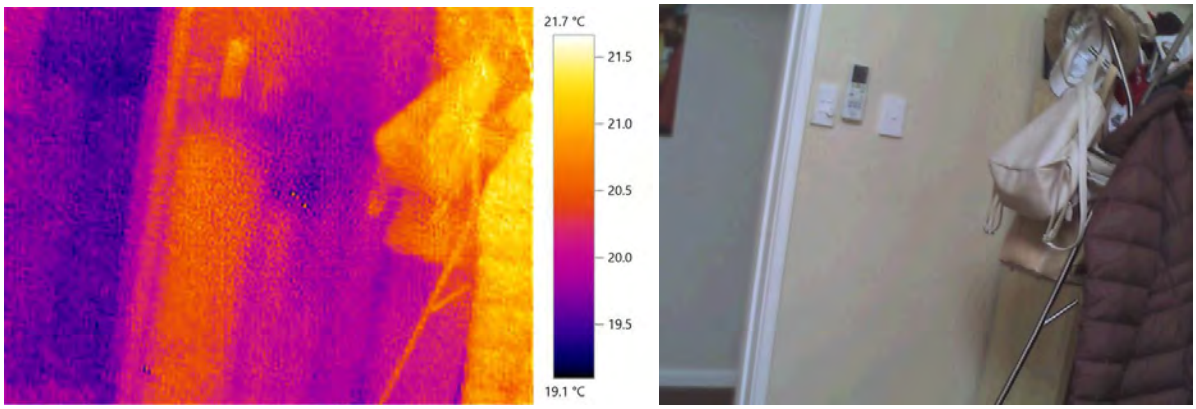


20. Thermography of living room.

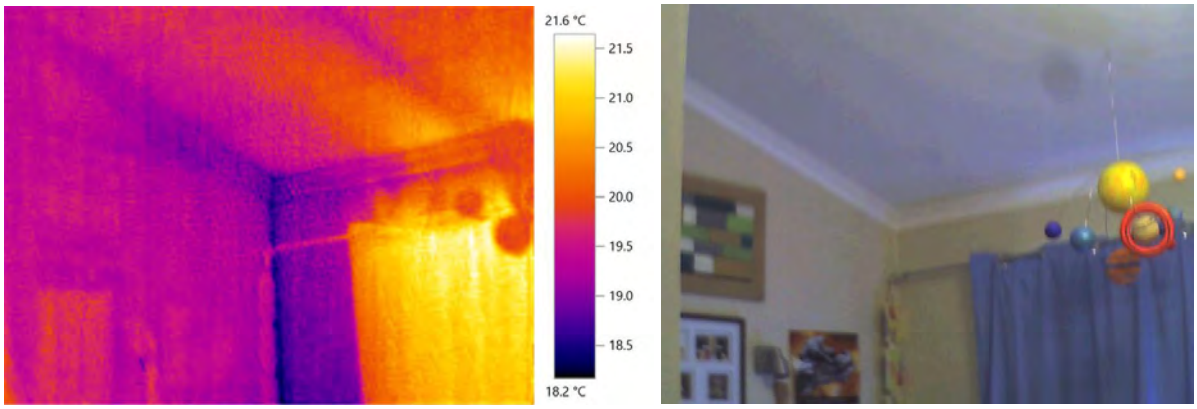


21. Thermography of kitchen A/C: seems dry enough underneath. Possible slight damp patch low down / at the noggings. Often an occasional overflow in humid weather, and/or the condensate pipe is leaking / blocked.





22. Thermography of son's bedroom.



23. Examples of viable airborne/surface sample results.

24. Examples of total-count microscopy sample results.