

# IN WATER-DAMAGED BUILDINGS

– SHOULD WE LOOK  
FOR

***“HIDDEN TREASURE”***



**NSJ ENVIROSCIENCES**  
*Because Health Matters*



# **CONFLICT DECLARATION**

**AUTHORED & PRESENTED BY:**

**DAVID LARK**

DIRECTOR

&

PRINCIPAL MYCOLOGIST

**NSJ ENVIROSCIENCES PTY LTD**

**NO OTHER CONFLICTS TO DECLARE**



**NSJ ENVIROSCIENCES**

*Because Health Matters*



# *The Challenge ... Remains*

**To use Evidence Based Science to  
Enable Evidence Based Medicine  
To Answer the Burning Question:**

**WILL THESE BUILDINGS  
MAKE YOU SICK?**



# **FLOODS IN OZ...**

**Devastation at Scale Never Recorded**

**90% OF AUSTRALIANS LIVE ON A  
COASTAL PLAIN**

**< 25KM FROM THE OCEAN**

**IS CLIMATE CHANGE REAL?**



# WHAT WAS THE CAUSE?

**Severe East Coast Low: Mar/Apr 2022**

**SOME AREAS IN CATCHMENTS  
FOR RIVERINE LOWLANDS AND DELTAS RECEIVED  
> 1 Metre (~40 inches) Rainfall in <24 hours**

**RESULTED IN RIVER FLOOD PEAKS > 2 M ABOVE  
PREVIOUSLY RECORDED LEVELS**

**“CLUSTER FLOODING” OCCURRING IN MANY AREAS**



# NOT ALL ABOUT FLOODS

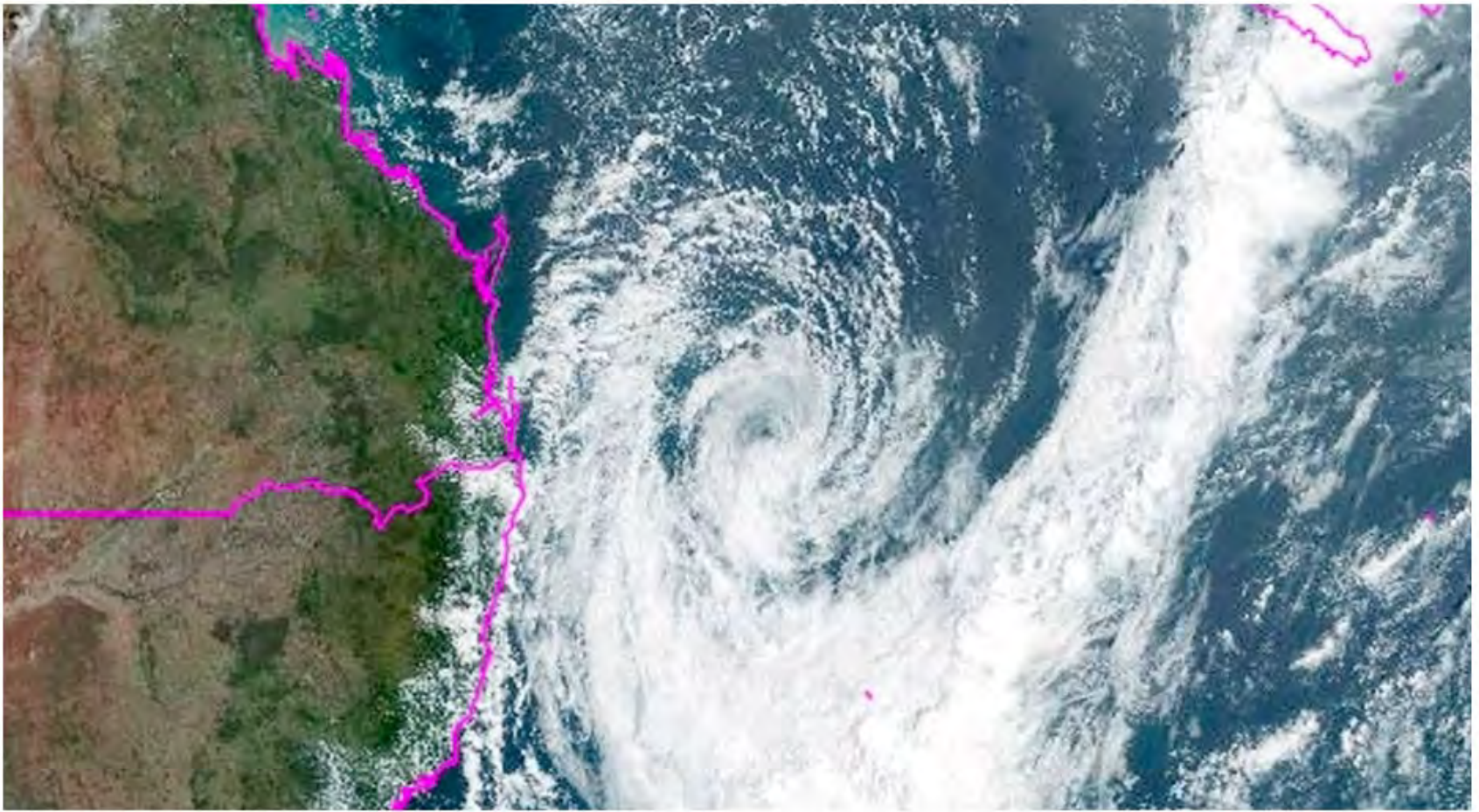
Massive five-metre waves batter Sydney's beaches



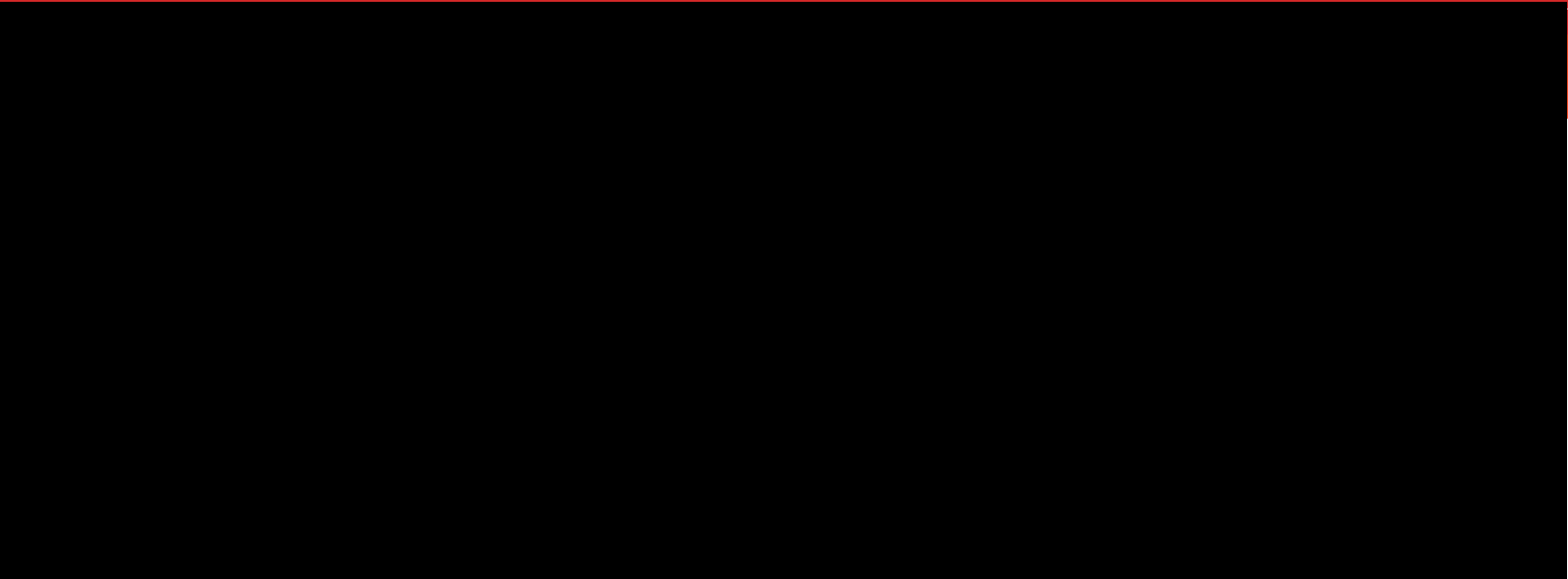
**HIGH SEAS ALSO COINCIDED  
WITH FLOODING**



# ECL FROM SPACE



# Aerial View of “Lake” Woodburn



**WOODBURN WAS OUR HOMETOWN FOR MORE THAN 2  
DECADES (1990 – 2010)  
MY SON AND HIS FAMILY SOLD THEIR PROPERTY  
THERE AND MOVED TO PERTH. WA  
3 WEEKS AHEAD OF THESE FLOODS**





# OUR HOME 1990-2010



**16 CEDAR STREET, WOODBURN  
10 HOMES FROM THE RICHMOND RIVER**



# SON'S HOME 1999-2022



**AT SWAN BAY ACROSS FROM THE RICHMOND RIVER**

**ON A KNOWL – NO PREVIOUS FLOOD IN HOUSE DURING PREVIOUS 120 YEARS**



# FLOOD IMAGES



The Richmond River fell below the major flood (Jones)



# HUMAN SUFFERING



# **POLLUTION, PLUS**

**It Never Rains but it Pours!!!**

**At least 4 Secondary Sewage Treatment Plants  
Carcasses of Dead Native Animals & Livestock  
Agrichemicals, inc. Fertilizers, Pest & Herbicides  
Sugar in Storage at 3 Mills  
Diesel/Fuel from Storage & Submerged Vehicles**

**DILUTION IS THE  
SOLUTION TO POLLUTION**



# **HIDDEN TREASURE**

## **BACK TO THE ENVIROBIOME...**

**FOCUS OF NGS SO FAR – mostly on Actinobacteria**

**Actino Score**

**Dominance Index**

**Prevalence Index**

**To find the HIDDEN TREASURE you need a map –**

**more on this in a moment – but first lets look at the treasure revealed so far....**



# NGS ADVANCES

CAN NGS RELIABLY I.D. & COUNT ?:

\* **F**UNGI



\* **A**CTINOBACTERIA



\* **O**TH**B**ACTERIA



# ACTINOS & CIRS

**Diagnostic Process for CIRS : Internal Medicine Review,  
Volume 4, Issue 5 May 2018**

**A Gene Primer for Health Care Providers: The Genomics  
of CIRS and Associated Molecular Pathways:  
Interpreting the Transcriptomics Results: Shoemaker R,  
Ryan J. eBook. 3/1/2018.**

**Medically sound investigation and remediation of water-  
damaged buildings in cases of CIRS-WDB. Part 1. Oct.  
15 [www.survivingmold.com](http://www.survivingmold.com).**

**Accessed 4/20/2018.**





# Actino Score

DERIVED FROM BACTERIAL  
ABUNDANCE/DIVERSITY MATRIX

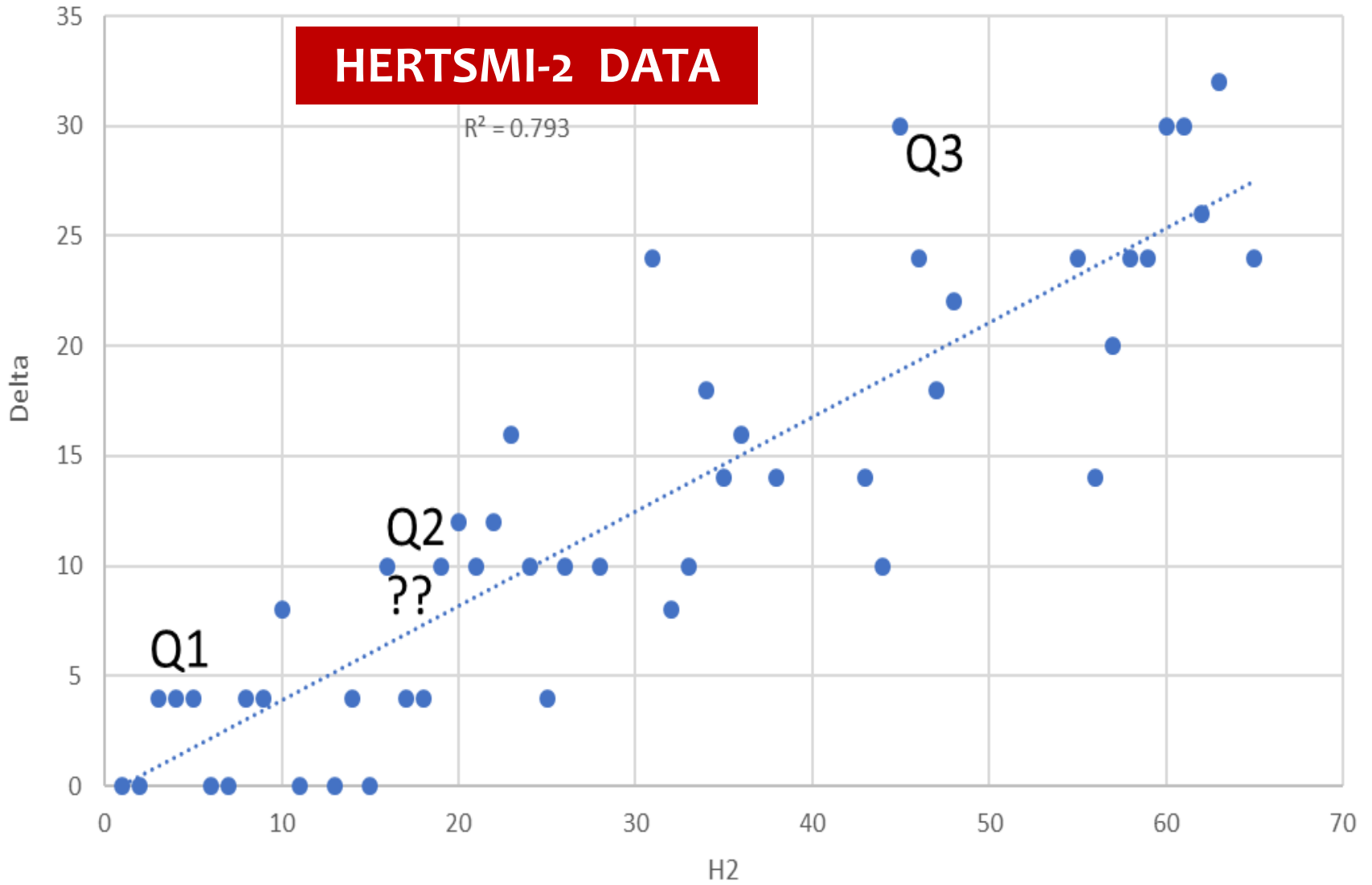
**0 -15      Normal**

**16 - 20      Further Investigation**

**> 20      Elevated**



# HERTSMI-2 DATA



# *Significant Findings*

**87% of Bacteria detected were  
Known Pathogens**

**45% were Actinobacteria**

**10% were Thermoactinomyces**

**42% were unaccounted for –**

**? Worth further investigation**



# CASE STUDY 1...

- **Residence in Tract Development – near Farmland**
- **Flooded – Apr. 2015**
- **Occupant & Family Unable to Remain in Residence**
- **Assessed by Numerous IEPs, OHs, etc – at least 10 !!!!!**
- **Disagreement as to Causation – Flood or Shower Leaks?**



# What's Your Vote?



# CASE STUDY 1...

## VIABLE CULTURE

		Bacteria cfu/plate	<i>Acromonium spp.</i>	<i>Alternaria spp.</i>	<i>Aspergillus spp.</i>	<i>Aspergillus niger</i>	Ascospores	<i>Chaetomium spp.</i>	<i>Cladosporium spp.</i>	Basidiospores	<i>Chrysomitia spp.</i>	<i>Dreschiera spp.</i>	<i>Eppiococcum spp.</i>	<i>Fusarium spp.</i>	<i>Geomyces spp.</i>	<i>Paecilomyces spp.</i>	<i>Penicillium spp.</i>	<i>Scopulariopsis spp.</i>	<i>Cunninghamella</i>	<i>Stachybotrys spp.</i>	<i>Trichoderma spp.</i>	Zygomycetes	Yeasts	Mould cfu/plate
22	Kitchen: Excised baseplate - outside wall	5			50												2							52
23	Lounge: Excised base plate - outside wall	6			>100			1						1					14					>116
24	Studio: Excised base plate - outside wall	20			>100			1					1											>102
25	Bedroom #1: Excised base plate - eastern outside wall	3	1	25																				26
26	Bedroom #3: Excised base plate - outside wall	6	1										1				8							10
Rating	Normal Mould Ecology	<50	50 - 100	100 - 250	>250	Elevated																		
		Further investigation is warranted when viable mould were detected on surfaces at concentrations between 50-100 cfu/plate or more than 25 cfu/plate if potentially pathogenic genera (in red) were detected.																						
		High																						
		Above 100 cfu/plate active mould contamination may have been present on the surface. The cause and source of the mould should be determined and redressed.																						
		Very High																						
If surface mould concentrations exceed 250 cfu/plate, very high mould contamination was present on these surfaces and remediation to remove the mould growth or cross contamination is required.																								



# CASE STUDY 1...

## TAPE LIFTS

		Mould/cm <sup>2</sup>	Slide Area Counted %	Fungal Hyphae	Un-ld Fungal Spores	Pollen	Gen Dirt & debris	<i>Ac. reamonium spp.</i>	<i>Alternaria spp.</i>	Ascospores	<i>Aspergillus/Penicillium</i>	Basidio spores	Bipolaris/Dreschleria	<i>Chaetomium spp.</i>	<i>Cladosporium spp.</i>	<i>Curvularia spp.</i>	<i>Epilicocum spp.</i>	<i>Fusarium spp.</i>	<i>Scoptulariopsis spp.</i>	<i>Pithomyces spp.</i>	<i>Tortula spp.</i>	<i>Siachybotrys spp.</i>	<i>Ulocladium spp.</i>	<i>Aureobasidium.</i>
6	Kitchen: Outside wall	1	50	1			LM								1									
7	Kitchen: Kitchen / lounge wall	5	50				LM			1												8		
8	Kitchen: Under excised base plate - outside wall	>2992	5	6	20		LM	5	3	>500	2			1		2					1			
9	Lounge: Lounge / kitchen wall	5	50	2			LM			1	5		1											
10	Lounge: Lounge / outside wall	BDL	50				LM																	
11	Lounge: Excised base plate - outside wall	>6283	5	>100	31		MH			2	>1000					1								
12	Studio: Outside wall	2	50				LM	1			2				1									
13	Studio: Studio / hall wall	1	50	1			LM							1										
14	Studio: Excised base plate - outside wall	>4898	5	>100	25		MH			4	>750	5												
15	Bedroom#1: Bedroom 1 / studio wall	BDL	50				LM																	
16	Bedroom#1: Outside wall	>6399	5	>100			M				55				>1000									
17	Bedroom#1: Window sill - eastern side	>7778	5	>100			H	4			>100				>1000									>200
18	Bedroom#1: Excised base plate - eastern outside wall	>4931	5	>100	20		MH	3	8	>750	2				1	4					2			
19	Bedroom#3: Outside wall	9	50	3			LM	1							12									
20	Bedroom#3: Bedroom 3 / hall wall	1	50	1			LM																	
21	Bedroom#3: Excised base plate - outside wall	>6820	5	>200	15		H				>1000	12				4								
	<b>Lower limit of detection = BDL 1 mould/cm<sup>2</sup> @ 50%</b>	<b>≤ 50</b>	<b>≤ 500</b>	<b>500 - 1000</b>	<b>1000 - 5000</b>	<b>&gt;5000</b>	<b>Elevated</b>																	
							Further investigation is warranted when mould spores + hyphae were detected on surfaces at concentrations greater than 500/cm <sup>2</sup> .																	
							<b>High</b>																	
							Where the total surface spore and hyphal concentration was above 1000/cm <sup>2</sup> active mould may have been present or cross contamination may have occurred. The cause and source of the mould should be determined and redressed.																	
							<b>Very High</b>																	
							When th+B20:Y31e surface mould spore & hyphal concentrations exceed 5,000/cm <sup>2</sup> active mould was present on these surfaces and remediation to remove the mould growth is required.																	



# CASE STUDY 1...

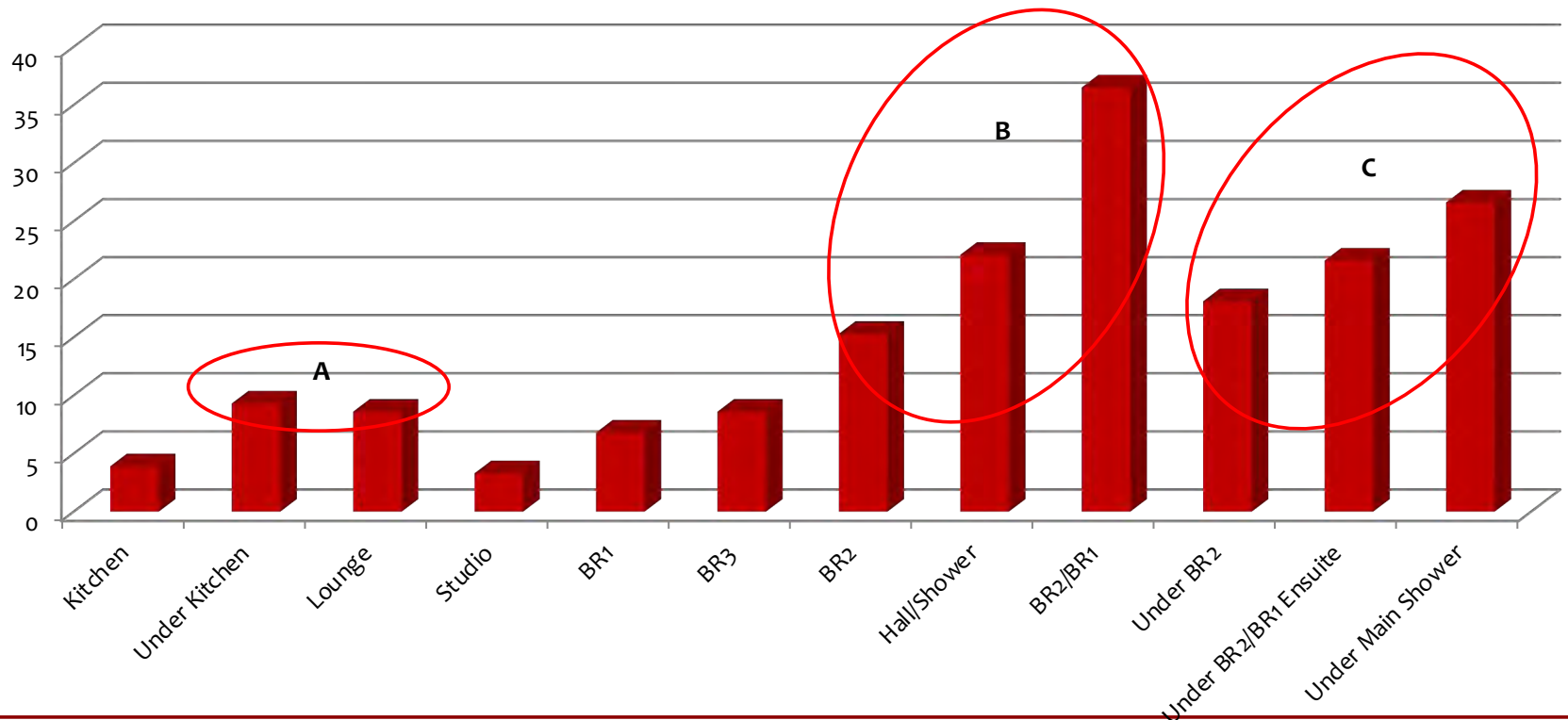
## SPORE TRAPS

		Mould/M <sup>3</sup>	Slide Area Counted %	Flow Rate l/min	Sample Time Minutes	Spores & Hyphae Counted	Fungal Hyphae	Un-Id Fungal Spores	Pollen	Gen Dirt & debris (H,M,L)	<i>Acremonium spp.</i>	<i>Alternaria spp.</i>	Ascospores	<i>Aspergillus/Penicillium</i>	Basidiospores	<i>Bipolaris/Dreschlera</i>	<i>Chaetomium spp.</i>	<i>Cladosporium spp.</i>	<i>Curvularia spp.</i>	<i>Epicoccum spp.</i>	<i>Fusarium spp.</i>	<i>Nigrospora spp.</i>	<i>Stemphylium spp.</i>	<i>Trichoderma spp.</i>	<i>Stachybotrys spp.</i>	<i>Scopulariopsis spp.</i>	<i>Spegazzinia spp.</i>
1	Outside air - Footpath (western end)	4053	25	15	5	76	11			M		6	7		5			36	3	1		5					2
2	Kitchen	4427	25	15	5	83	17	4		MH		4	2	18	1		1	26		3		7					
3	Lounge	3733	25	15	5	70	12	4		MH		5	3	6	3	1		27	2	3		3			1		
4	Studio	4373	25	15	5	82	13			M		2	3	28		2	2	29	2	1							
5	Bedroom #1	3733	25	15	5	70	10			M		2	2	21				20		3		1				11	
41	Bedroom #3	3733	25	15	5	70	10			M			5	24				31									
Rating	Lower limit of detection = BDL <53 Mould/M <sup>3</sup> @25%	<100	<1000	1000 - 4225	4225 - 10000	>10000	Elevated <sup>5</sup>																				
	Low	Normal Mould Ecology	Elevated	High	Very High	Further investigation is warranted when mould spores & hyphae were detected in the air at concentrations greater than 1000/M <sup>3</sup> .																					
						High <sup>5</sup>																					
						Where the airborne mould spore & hyphal concentration were above 4,225/M <sup>3</sup> active mould may have been present. The cause & source of the mould should be determined and redressed.																					
Very High <sup>5</sup>																											
If the airborne mould spore & hyphal concentrations exceed 10,000/M <sup>3</sup> all occupants should be excluded. However, if occupants have predisposing health conditions, lower exclusion limits should be considered.																											





## ERMI Values



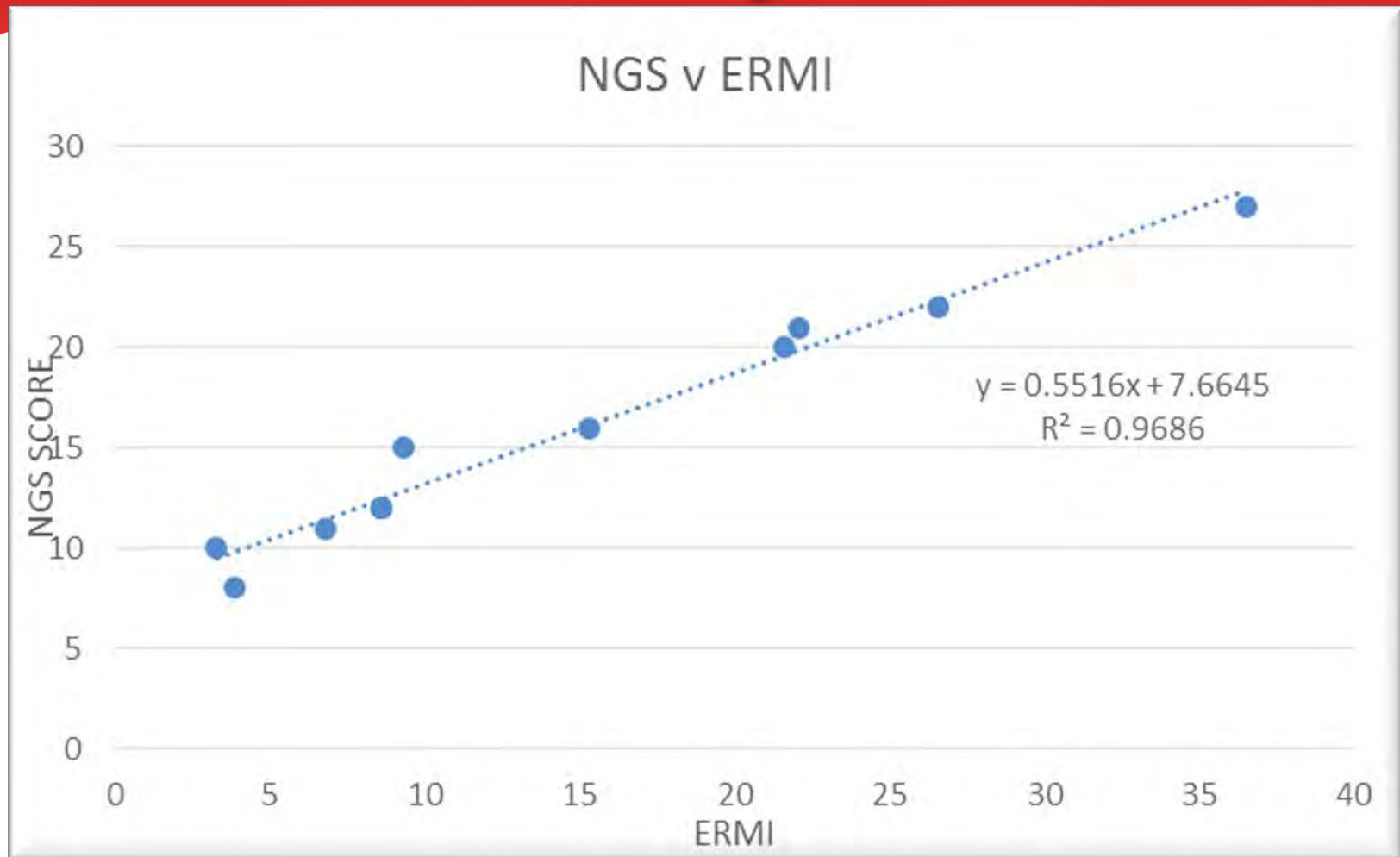
**A:** Kitchen end of house – moderate rise in mould indicated by ERMI - thought to be the point where flooding entered the subfloor and accumulated against the foundation wall.

**B:** Bedroom/bathroom end of house – where moisture from the leaking showers has allowed extensive mould amplification as indicated by the elevated ERMI's

**C:** Underfloor samples taken from visible mould present on the underside of the particleboard flooring adjacent to areas of water damage.



# Case Study 1 - NGS



# SUMMARY

Between Baseplate & Floor	Tape Lift Mold/cm2	ERMI	Predominant Molds
Kitchen	>500 Asp/Pen 5 Alternaria 2 Epicoccum	3.9	Asp. ochraceus Asp. restrictus Cl. sphaerospermum
Lounge	>1000 Asp/Pen 1 Epicoccum	8.6	Asp. restrictus Asp. versicolor E. amstelodarmi Wallemia sebi
Studio	>750 Asp/Pen	3.3	Asp. restrictus Wallemia sebi
BR 1	>750 Asp/Pen 3 Alternaria 4 Epicoccum	6.8	Asp. ochraceus Asp. restrictus Asp. versicolor Wallemia sebi
BR3	>1000 Asp/Pen 4 Epicoccum	8.6	Asp. ochraceus Asp. restrictus Asp. versicolor Wallemia sebi
BR2	>1000 Asp/Pen	15.3	Asp. ochraceus Asp. restrictus Asp. versicolor
Hall/Shower Wall	>1000 Asp/Pen 4 Cheat.	22.1	Asp. versicolor Cheatomium globosum Stachybotrys chatarum Wallemia sebi
BR2/BR1 Ensuite	>1000 Asp/Pen 4 Cheat 12 Stachy	36.5	Asp. ochraceus Asp. restrictus Asp. sydowii Asp. unguis Asp. versicolor Cheatomium globosum E. amstelodarmi Pen. crustosum Pen. purpurogenum Scop. bevicaulis Scop. chatarum Stachy. chatarum Wallemia sebi

NGS - All samples under baseplates  
 NGS > 20, predominantly Actinos, including *Saccharopolyspora rectivirgula*  
 Hypersensitivity pneumonitis – “dust” Dx – Farmer’s Lung



Table 1

**Summary of total bacteria's species**

Bacteria	Types
Totals	131
Pathogen	9

Box 1

Actinomycetales	Types
Totals	11
Pathogenic	0

Box 2

**Selected actinomycetales found  
in water damaged buildings**

Mycobacteria	Types
Totals	1
Pathogenic	0

Streptomyces	Types
Totals	2
Pathogenic	0

Box 3

Non Actinomycetales	Types
Totals	120
Pathogenic	9

Box 4



# “HIDDEN TREASURE” ...

Table 4

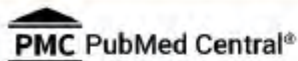
## Pathogenic Non-Actinomycetales

BE/mg= Bacteria's equivalent / milligram of sample

Families	Genus	Species	BE/mg**
<b>Bacillaceae</b>			
1	Bacillus	cereus	180
2	Bacillus	infantis	62
3	Bacillus	megaterium	133
<b>Burkholderiaceae</b>			
4	Burkholderia	fungorum	19, 867
<b>Clostridiaceae</b>			
5	Clostridium	botulinum	152
6	Clostridium	cadaveris	55
7	Clostridium	histolyticum	148
8	Clostridium	perfringens	51



# DATABASE SEARCHES



Search PMC Full-Text Archive

Search

[Journal List](#) > [Nucleic Acids Res](#) > [v.35\(Database issue\); 2007 Jan](#) > [PMC1751540](#)

OTI

- **Database Automation – Examples of Significant Microbial “Isolates” were to follow, but .....**

[Nucleic Acids Res.](#) 2007 Jan; 35(Database issue): D347–D353.

PMCID: PMC1751540

Published online 2006 Dec 1. doi: [10.1093/nar/gkl947](#)

PMID: [17145713](#)

The National Microbial Pathogen Database Resource (NMPDR): a genomics platform based on subsystem annotation

[Leslie Klis McNeil](#),<sup>1,\*</sup> [Claudia Reich](#),<sup>1,2</sup> [Ramy K. Aziz](#),<sup>3</sup> [Daniela Bartels](#),<sup>4</sup> [Matthew Cohoon](#),<sup>4</sup> [Terry Disz](#),<sup>4</sup> [Robert A. Edwards](#),<sup>5,6,7</sup> [Svetlana Gerdes](#),<sup>5</sup> [Kaitlyn Hwang](#),<sup>4,8</sup> [Michael Kubal](#),<sup>4</sup> [Gohar Rem Margaryan](#),<sup>4</sup> [Folker Meyer](#),<sup>4,8</sup> [William Mihalo](#),<sup>4</sup> [Gary J. Olsen](#),<sup>2</sup> [Robert Olson](#),<sup>4</sup> [Andrei Osterman](#),<sup>5,7</sup> [Daniel Paarmann](#),<sup>4</sup> [Tobias Paczian](#),<sup>4</sup> [Bruce Parrello](#),<sup>5</sup> [Gordon D. Pusch](#),<sup>4,5</sup> [Dmitry A. Rodionov](#),<sup>7</sup> [Xinghua Shi](#),<sup>4</sup> [Olga Vassieva](#),<sup>5,9</sup> [Veronika Vonstein](#),<sup>5</sup> [Olga Zagnitko](#),<sup>5</sup> [Fangfang Xia](#),<sup>4</sup> [Jenifer Zinner](#),<sup>4</sup> [Ross Overbeek](#),<sup>5</sup> and [Rick Stevens](#)<sup>4,8</sup>

• [Author information](#) • [Article notes](#) • [Copyright and License information](#) • [Disclaimer](#)



# Burkholderia fungorum

## References

*Biodegradation of Phenanthrene and Heavy Metal ....* (2022). Retrieved on April 16, 2022, from <https://www.frontiersin.org/articles/10.3389/fmicb.2019.00408/full>.

*Burkholderia fungorum Coenye et al. | ATCC.* (2022). Retrieved on April 16, 2022, from <https://www.atcc.org/products/baa-463>.

*Burkholderia fungorum DBT1: a promising bacterial strain for ....* (2022). Retrieved on April 16, 2022, from <https://academic.oup.com/femsle/article/319/1/11/552555>.

*Burkholderia fungorum Septicemia.* (2022). Retrieved on April 16, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3371813/>.

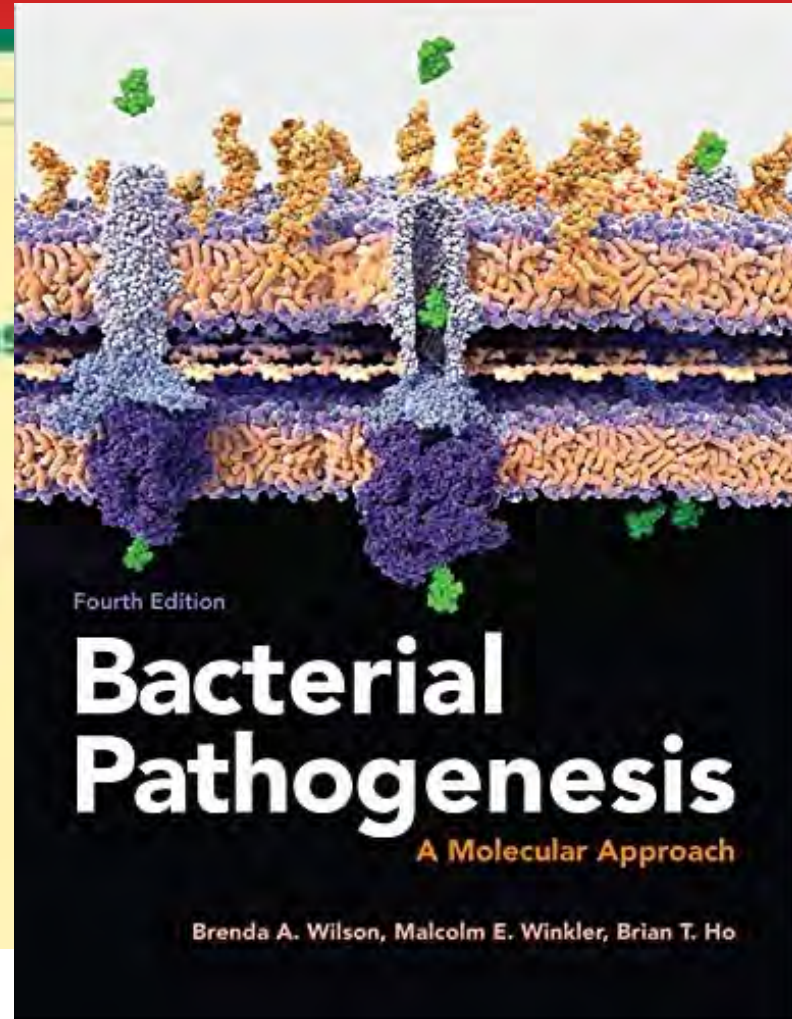
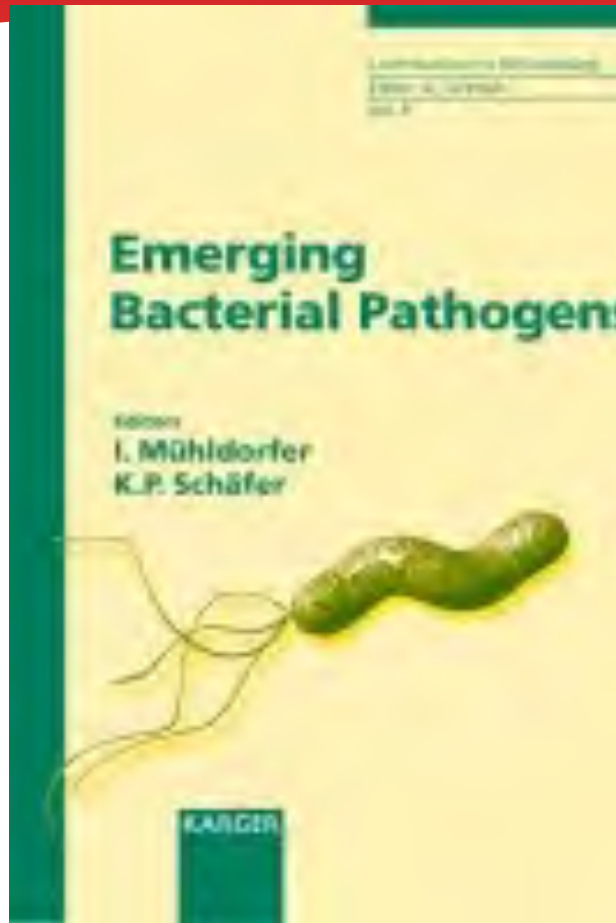
*Burkholderia fungorum promotes common bean growth in a ....* (2022). Retrieved on April 16, 2022, from <https://annalsmicrobiology.biomedcentral.com/articles/10.1007/s13213-014-1020-y>.

*Burkholderia fungorum sp. nov. and Burkholderia caledonica sp ....* (2022). Retrieved on April 16, 2022, from <https://pubmed.ncbi.nlm.nih.gov/11411678/>.

*Burkholderia.* (2022). Retrieved on April 16, 2022, from <https://microbewiki.kenyon.edu/index.php/Burkholderia>.



# RECENT PUBLICATIONS





# Is this REALITY?

- **NGS IS A VALUABLE SERVICE**



- **IMO THOSE WHO LIVE IN WDB (FLOODED OR OTHERWISE)**
- **DESEARVE TO KNOW WHAT THEY ARE EXPOSED TO SO THAT THEIR EXPOSURE**
- **IS NO LONGER “HIDDEN” BUT THE REALITY OF**
- **DETECTION BECOMES THE “TREASURE”**



# Thomas' Postulates



1972

- IT'S NOT – THE DOSE
- IT'S NOT – THE PAMPs or DAMPs
- IT'S NOT – THE INFLAMMAGENs
- IT'S NOT – THE BIOTOXINs
- IT ***IS*** – “THE RESPONSE “ THAT “MAKES THE DISEASE”

Lewis Thomas , MD (NEJM 1972; 287: 553-555)



# NOW and the FUTURE..

- EXPAND THE DATA DEPTH & CORRELATIONS – GENIE
- EXPAND THE RANGE & SCOPE OF DATABASES ACCESSED
- BETTER BIOINFOMATICS & DATA REDUCTION 
- CORRELATE WITH CLINICAL & ENVIRO. DATA (HIPAA)
- COMPARE NEXTGEN WITH TRANSCRIPTOMICS 
- EXPAND NGS DIAGNOSTIC CAPABILITY TO THE MANAGEMENT OF MICROBIALLY RELA

F.A.B



# THANK YOU FOR YOUR ATTENTION

QUESTIONS  
WILL BE  
ADDRESSED IN  
THE PANEL  
DISCUSSION



**NSJ ENVIROSCIENCES**  
*Because Health Matters*

[david@nsjenviro.com.au](mailto:david@nsjenviro.com.au)

Copyright NSJ EnviroSciences

- 2022

