GBR Catchment Loads Monitoring Program –Where there's a will there's a way - Positive impacts of extension on pesticide risk

Reinier Mann,
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Science and Innovation

CATCHMENT WATER QUALITY ALLIANCE

The Catchment Water Quality Alliance is a collaboration between the DETSI - Water Quality & Investigations, The University of Queensland - Reef Catchment Science Partnership and the James Cook University - TropWATER

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Water Quality & Investigations

Queensland Government
Department of the Environment, Tourism, Science and Innovation

Reef Catchments Science Partnership
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The University Of Queensland
AUSTRALIA

TropWATER
Centre for Tropical Water and Aquatic Ecosystem Research

James Cook University
AUSTRALIA

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Who's part of the Alliance: Christian Witte, Reinier Mann, Ryan Turner, Zoe Bainbridge, Celine Clech-Goods, Rochelle Wessels, Melanie Shaw, David Orr, Ben Ferguson, Angela March, Richard Gardiner, Rae Huggins, Kylee Welk, Jennifer Strauss, Shaun Fisher, Stephen Wallace, Cameron Roberts, Joe Versace, Justin Mendelow, Eloise Wilson, Mika Rowston, Hannah Mitchell, Ben Houseman, Hayley Kaminski, Steph Atkinson, Zach Stibbard, Cheng Lu, Joseph McMahon, Payton Te Ngaio, Chalier Ortiz

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Are Pesticides Concentrations Increasing or Decreasing in Waterways that Discharge to the Great Barrier Reef Lagoon?

Heinrich Rass

Supervised by Associate Professor Michael Warne, Dr. Ryan Turner, and Dr. Alan Huang

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Assessing long temporal trends of time-series Potentially Affected Fraction (PAF) on the Great Barrier Reef rivers

Nattapat Attagad

Supervised by Dr. Ryan Turner, Dr. Reinier Mann, Catherine Neelamjaru, Hayley Kaminski, and Alan Huang

Hannah Mitchell

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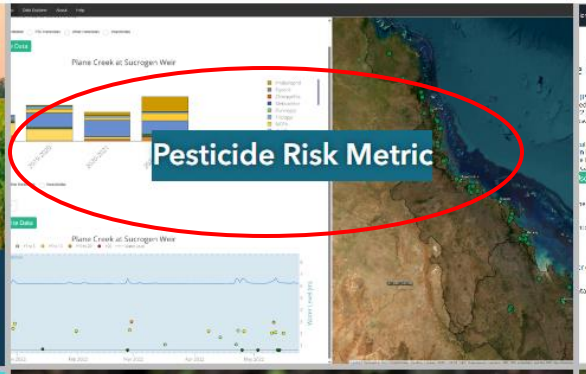
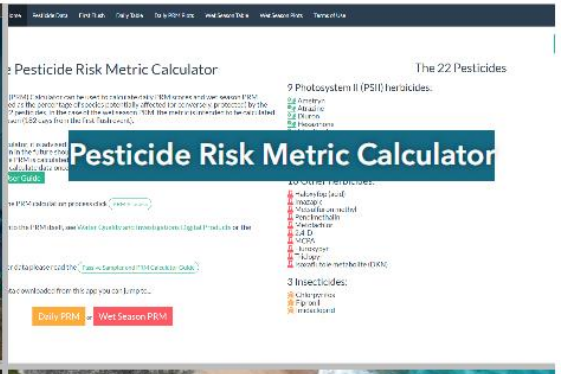
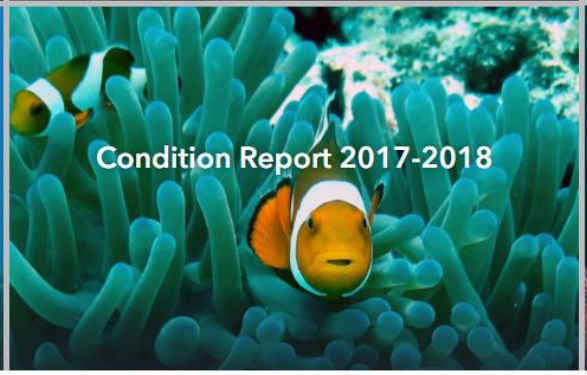
Water Quality & Investigations Digital Products







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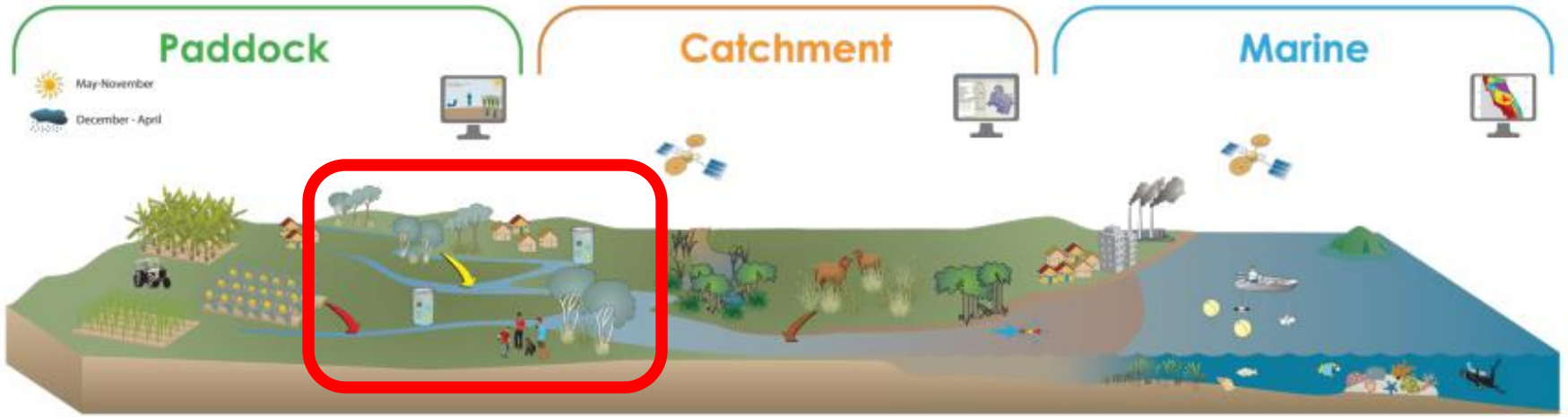
There are 14 program components, which are integrated through a common assessment and reporting framework.



Stewardship

- Agricultural land management practice adoption
- Social factors influencing agricultural land management practice adoption
- Economic benefits of agricultural land management practices
- Non-agricultural management practice adoption

Marine condition

- Marine monitoring program
  - Water quality monitoring
  - Seagrass monitoring
  - Coral monitoring
- eReefs marine modelling

Management practice effectiveness and paddock pollutant delivery (agricultural land uses)

- Paddock monitoring of water quality benefits
- Paddock modelling of practice effectiveness (water quality)

Catchment pollutant delivery

- Catchment loads monitoring
- Catchment loads modelling

Catchment condition

- Ground cover monitoring
- Riparian vegetation extent monitoring
- Wetland extent monitoring
- Wetland condition and pressure monitoring

P2R Program

- 14 components
- Loads monitoring
- Catchment scale (with some fine scale projects)

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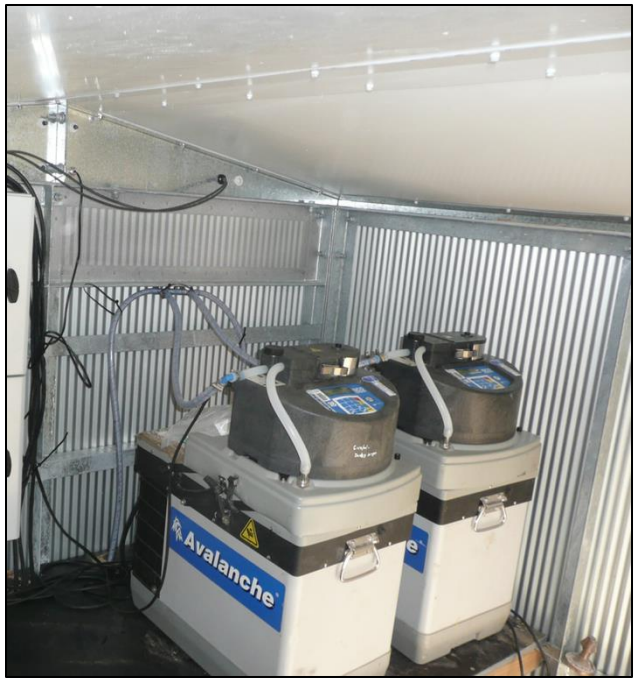

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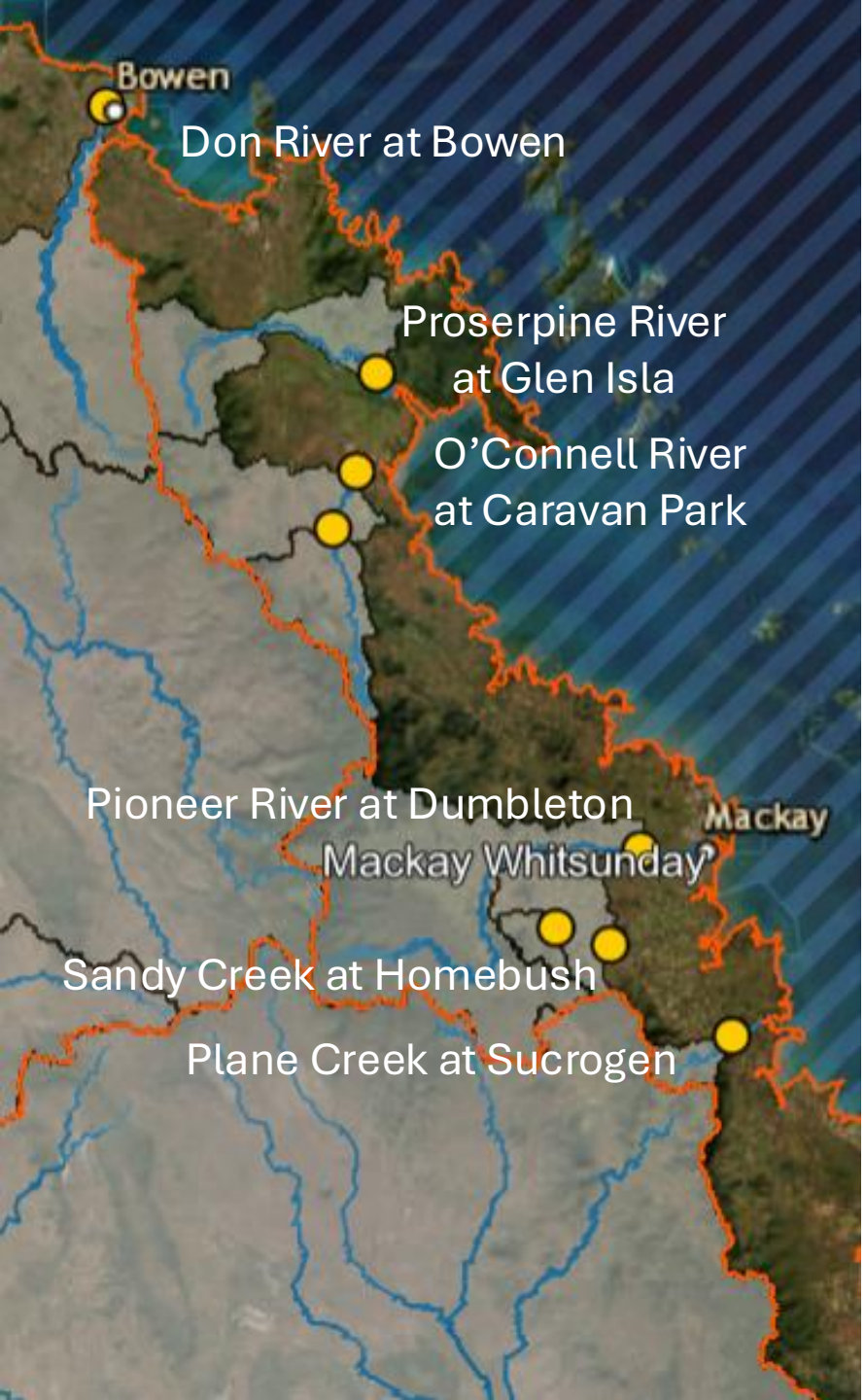
Monitoring Sites (2022 -2023)

- 68 sites were monitored within 25 basins.
- Total suspended solids and nutrients were monitored at 26 end-of-catchment sites, 22 sub-catchment sites and 8 fine-scale monitoring sites.
- Pesticides were monitored at 27 end-of-catchment sites, 9 sub-catchment sites and 9 fine-scale monitoring sites

CATCHMENT WATER QUALITY ALLIANCE



Monitoring Sites in Mackay Whitsunday

- 4 sites have long temporal data sets

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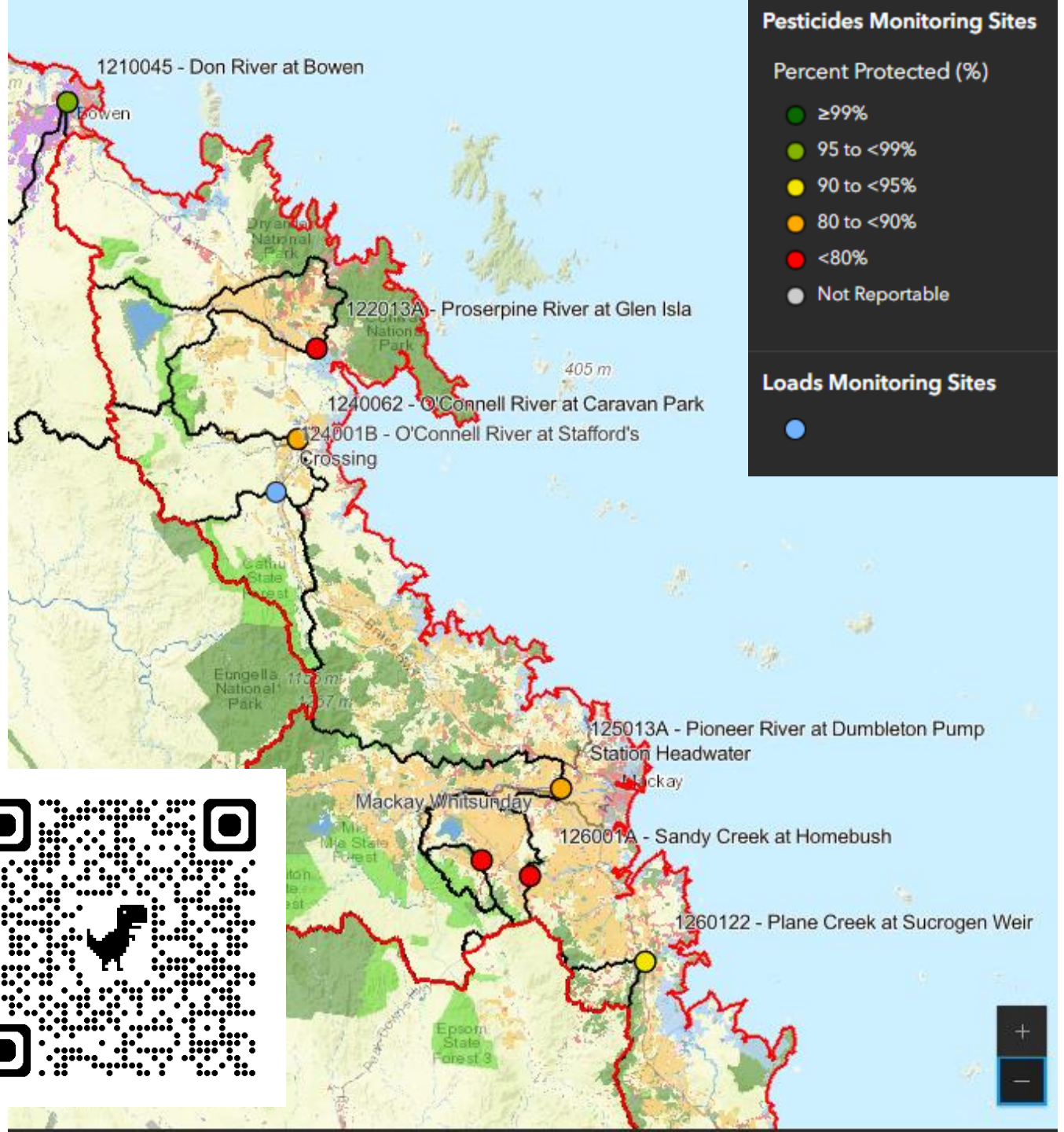
Pesticide Risk in Mackay Whitsunday



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Pesticide Risk in Mackay Whitsunday

Region	Site Name	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Mackay Whitsunday	O'Connell River at Caravan Park	92.3	87.6	92.1	91.9	92.3	87.1	89.8	88.2	92.8
Mackay Whitsunday	O'Connell River at Stafford's Crossing		87.8	91.7	92.5	89.7				
Mackay Whitsunday	Pioneer River at Dumbleton Pump Station Headwater	81.9	83	75.1	84.6	78.5	76.9	85.5	83.4	80.3
Mackay Whitsunday	Pioneer River at Forgan Smith Bridge				87.3					
Mackay Whitsunday	Plane Creek at Sucrogen Weir			93.1	95.9	94.2	95.3	92.8	93.4	95.7
Mackay Whitsunday	Proserpine River at Glen Isla		73	70.6	65.9	70.8	73.6	65.4	72	65.9
Mackay Whitsunday	Sandy Creek at Bruce Highway				66.4					
Mackay Whitsunday	Sandy Creek at Homebush	59.7	61.1	57.7	63.5	66.6	57.9	63.9	64.9	59.3
Mackay Whitsunday	Sandy Creek South Branch at Downstream Sorbellos Road							77	71.9	

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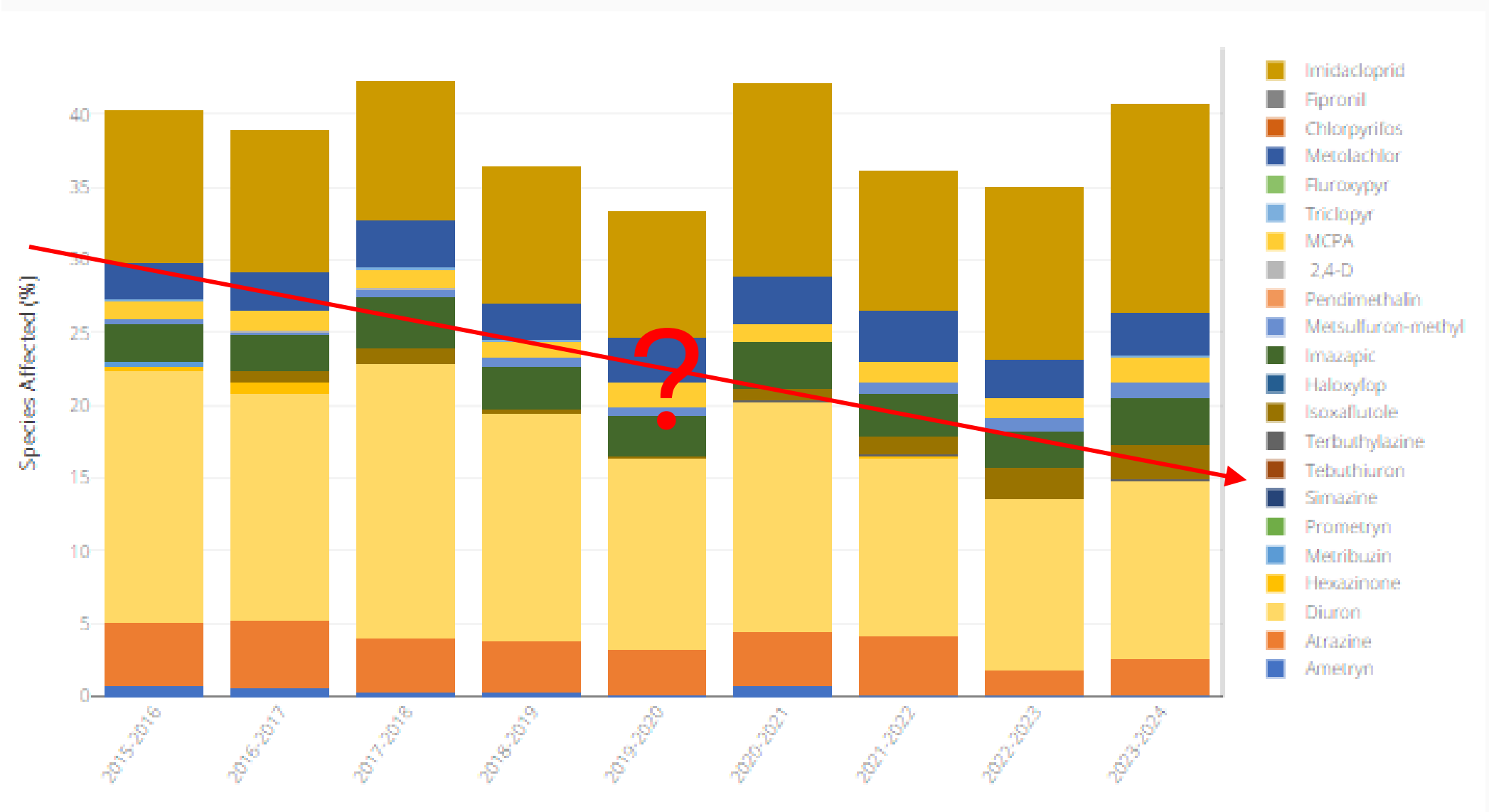
Contributions to Pesticide Risk in Mackay Whitsunday



Sandy Creek at Homebush

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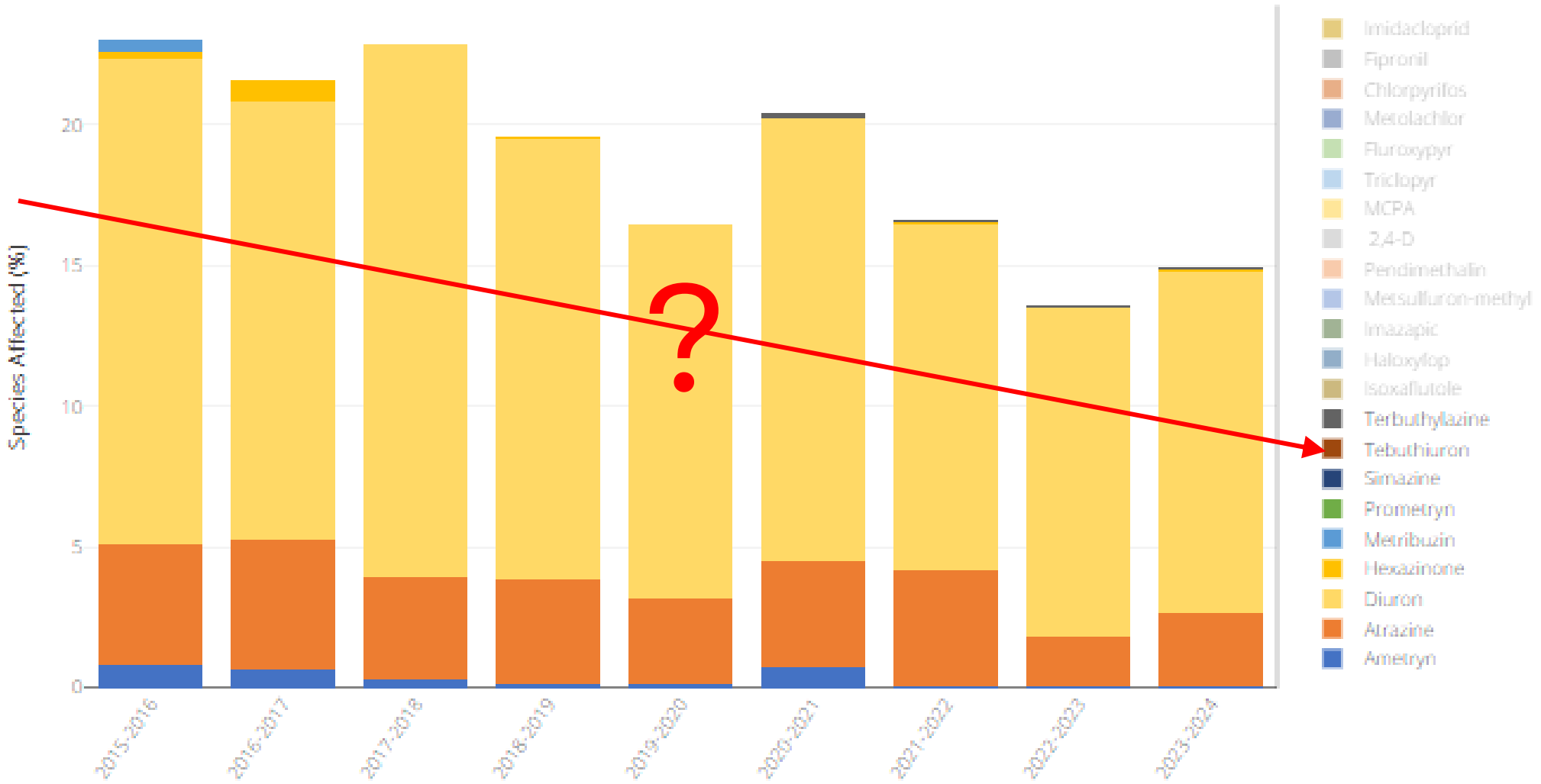
PSII contributions to Pesticide Risk in Mackay Whitsunday



Sandy Creek at Homebush

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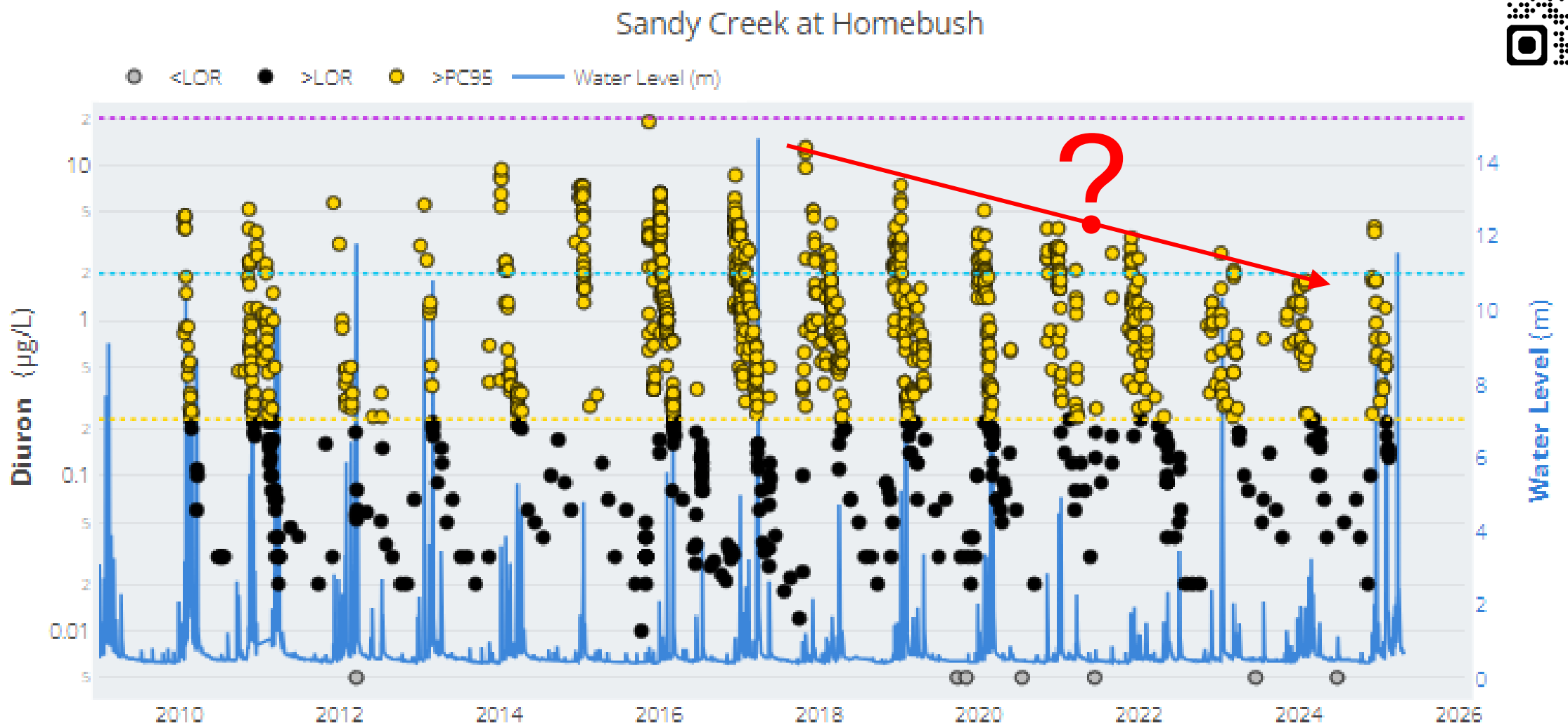
Diuron concentrations in Sandy Creek



Diuron

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Interventions

- APVMA changes to diuron labels in 2012
- Promotion of the use of non-residual knockdown herbicides in preference to residual PSIIs since 2009
- Sandy Creek Projects between 2015 and 2020 – increased awareness
- WQI released new guidelines for chemicals like diuron and imidacloprid
- Publication of guideline exceedances by WQI and later the publication of the Pesticide Reporting Portal
- Development and Adoption of the Pesticide Risk Metric
- Awareness programs and field trials for products containing imidacloprid
- Bluewater 1 and Bluewater 2 – Farmacist
- Pesticide Decision Support Tool (Michael Warne & Farmacist) and the Pesticide Projector (RCSP & TRUII)
- Biosecurity Queensland have recently run compliance & awareness programs

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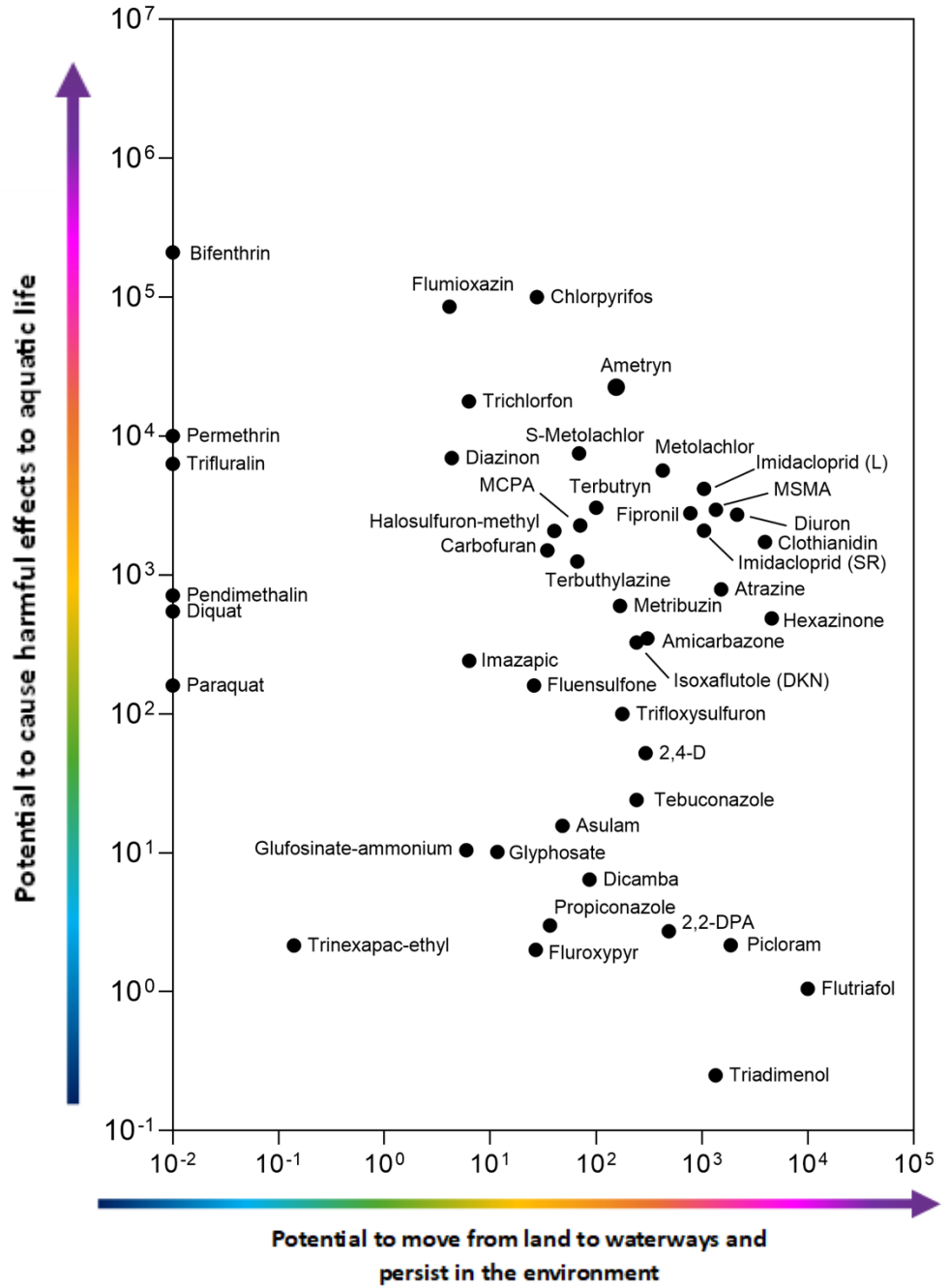
Pesticide Decision Support Tool for sugarcane

- 45 active ingredients registered for application on sugarcane.
- Based on maximum application rate and broadcast spray regime.



pesticide projector

Truii

Reef Catchments Science Partnership
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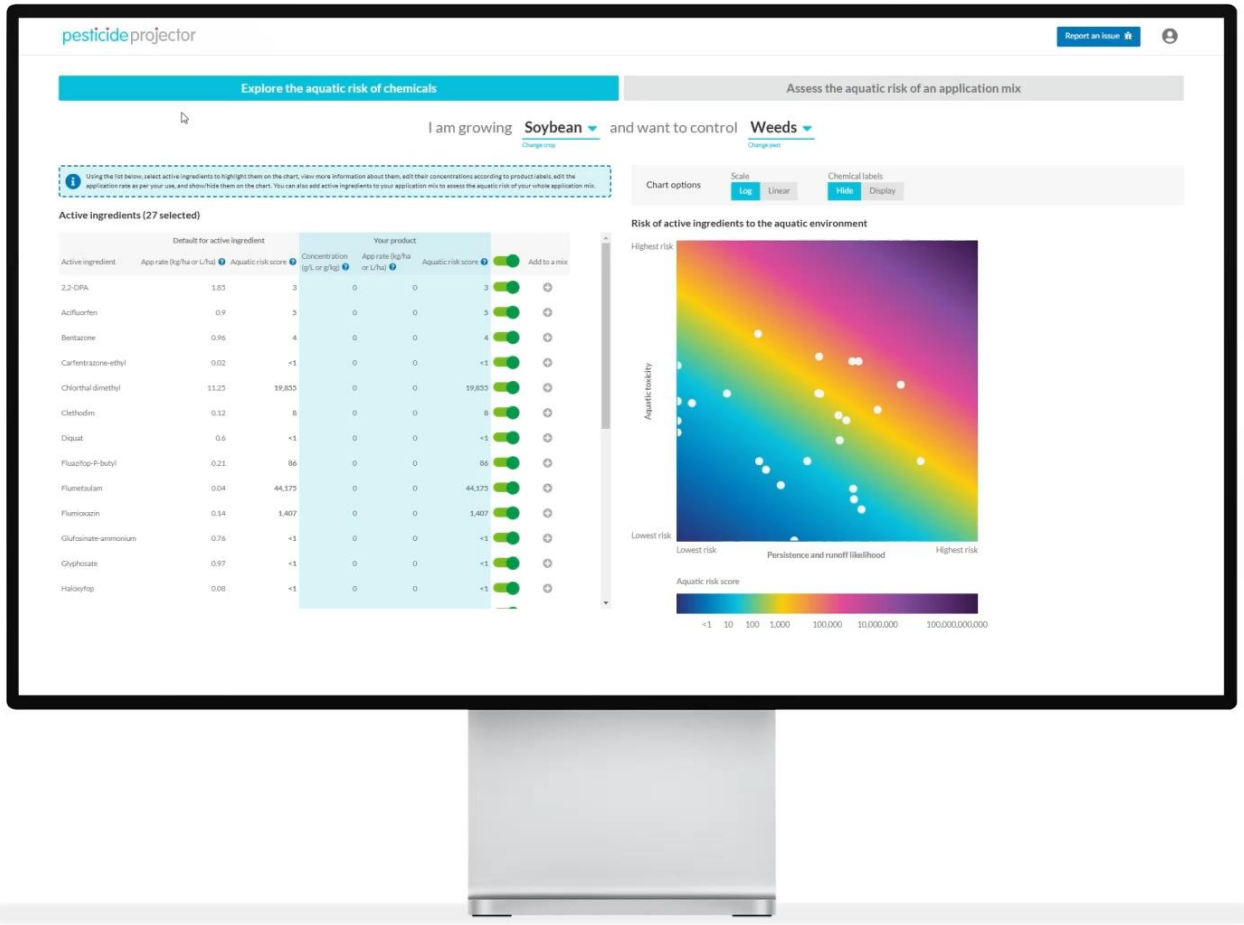


- User-friendly platform that can be tailored to actual individual farm practices, dealing with:
  - ✓ User application rates
  - ✓ Tank mixes
  - ✓ Different spray methods
- Includes active ingredients applied on **sugarcane, rotation crops** and **bananas.**

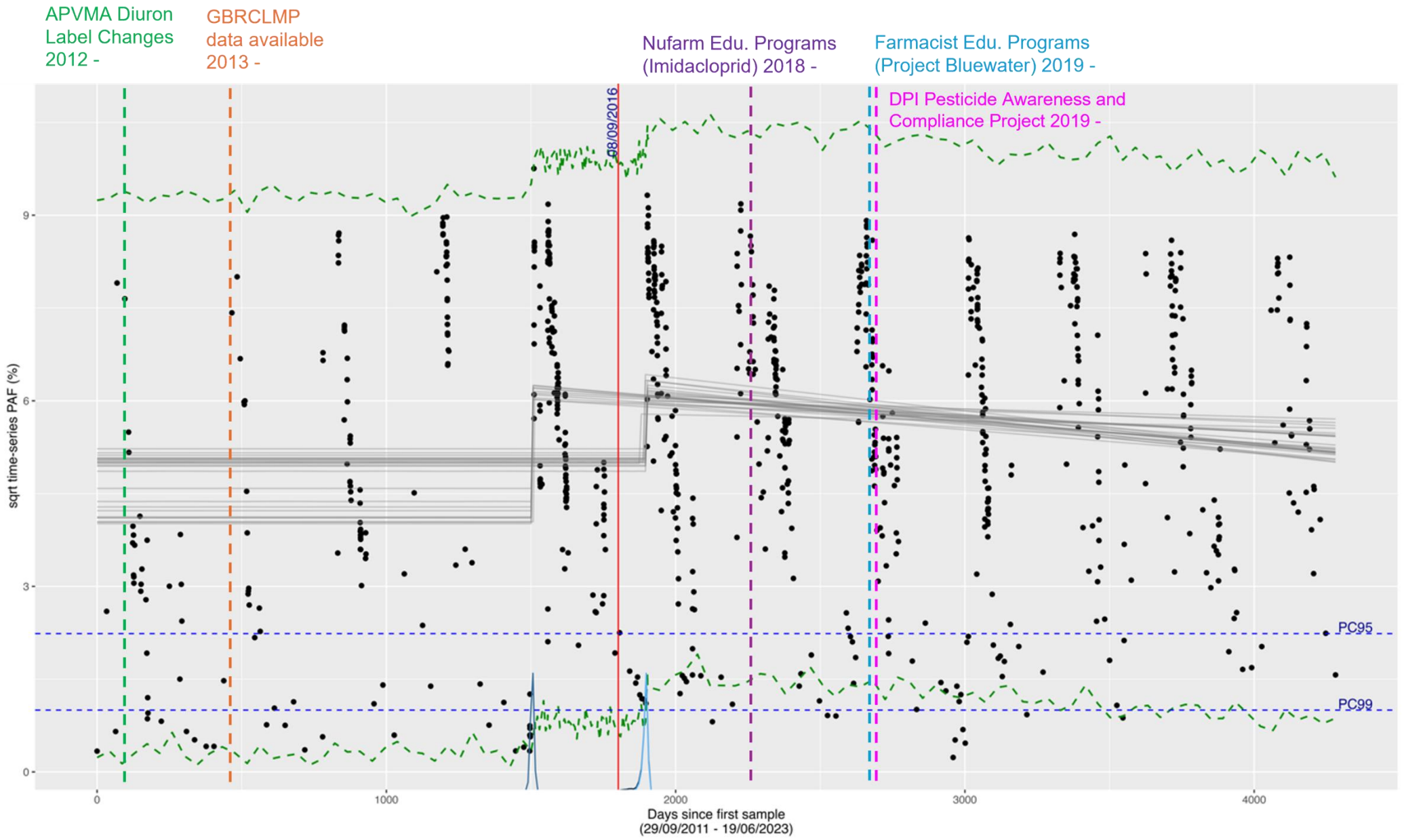
pesticideprojector.net.au

Project Bluewater

- **Implementing the Pesticide Decision Support Tool in the field**

- 10,500 hectares in predominant sugarcane growing areas in Mackay, Queensland.
- Sprayer assessments and upgrades.
- Used the Pesticide Decision Support Tool in pesticide management plans for each block, based on pest and site-specific characteristics (e.g., soil type, slope, proximity to sensitive sites).

Sandy Creek at Homebush – Total (22) Pesticides



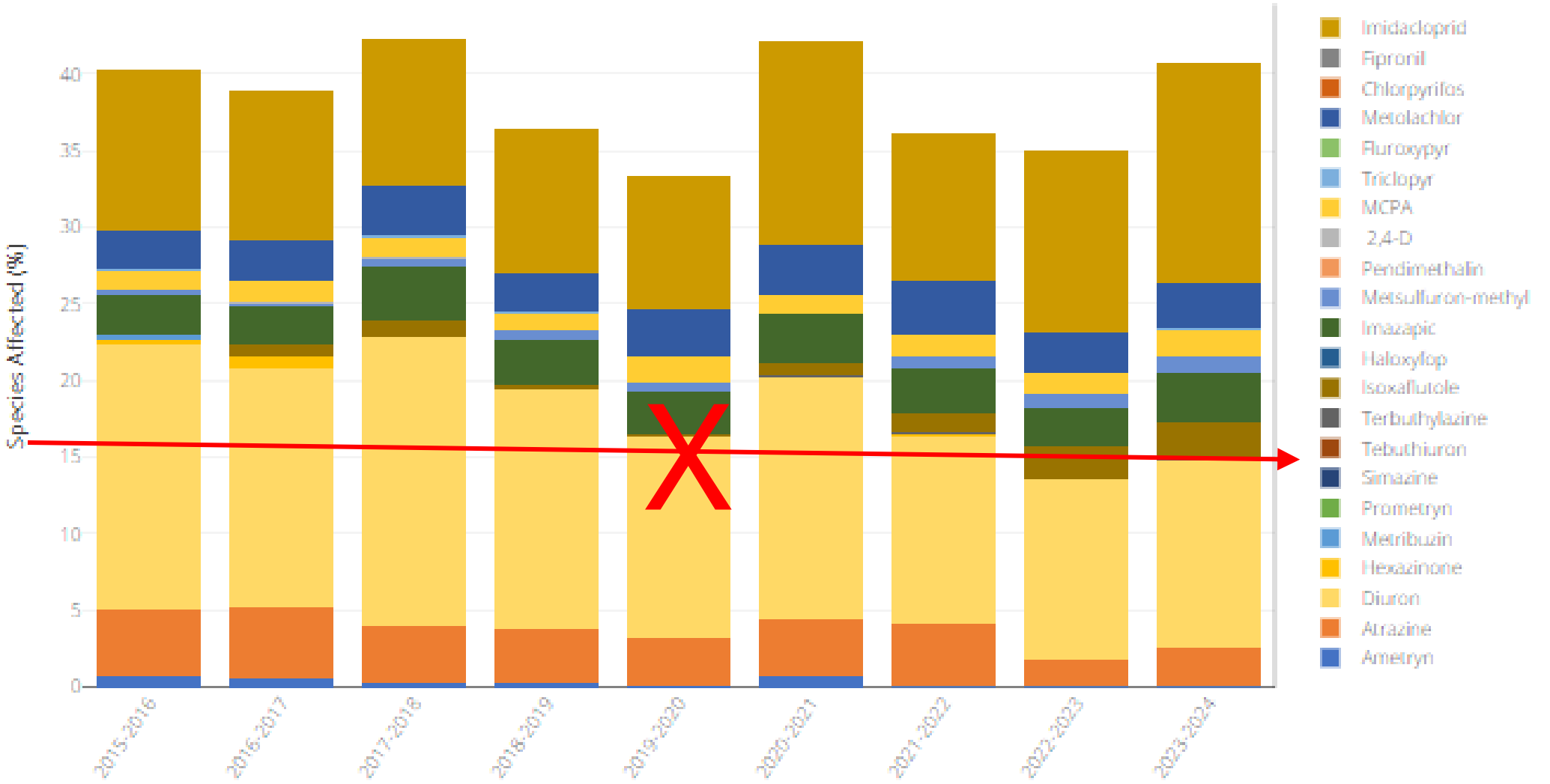
Seasonal Mann-Kendall Analyses

Non- significant trend for Total Pesticides ($p = 0.085$)

Statistically significant decrease in PSII herbicides ($p = 0.021$)

Attagad, Nattapat (2024). *Assessing long temporal trends of timeseries Potentially Affected Fraction (PAF) on the Great Barrier Reef rivers.* Honours Thesis, School of the Environment, The University of Queensland. https://doi.org/10.14264/2da064b

Total Pesticides in Sandy Creek



Sandy Creek at Homebush

P = 0.085

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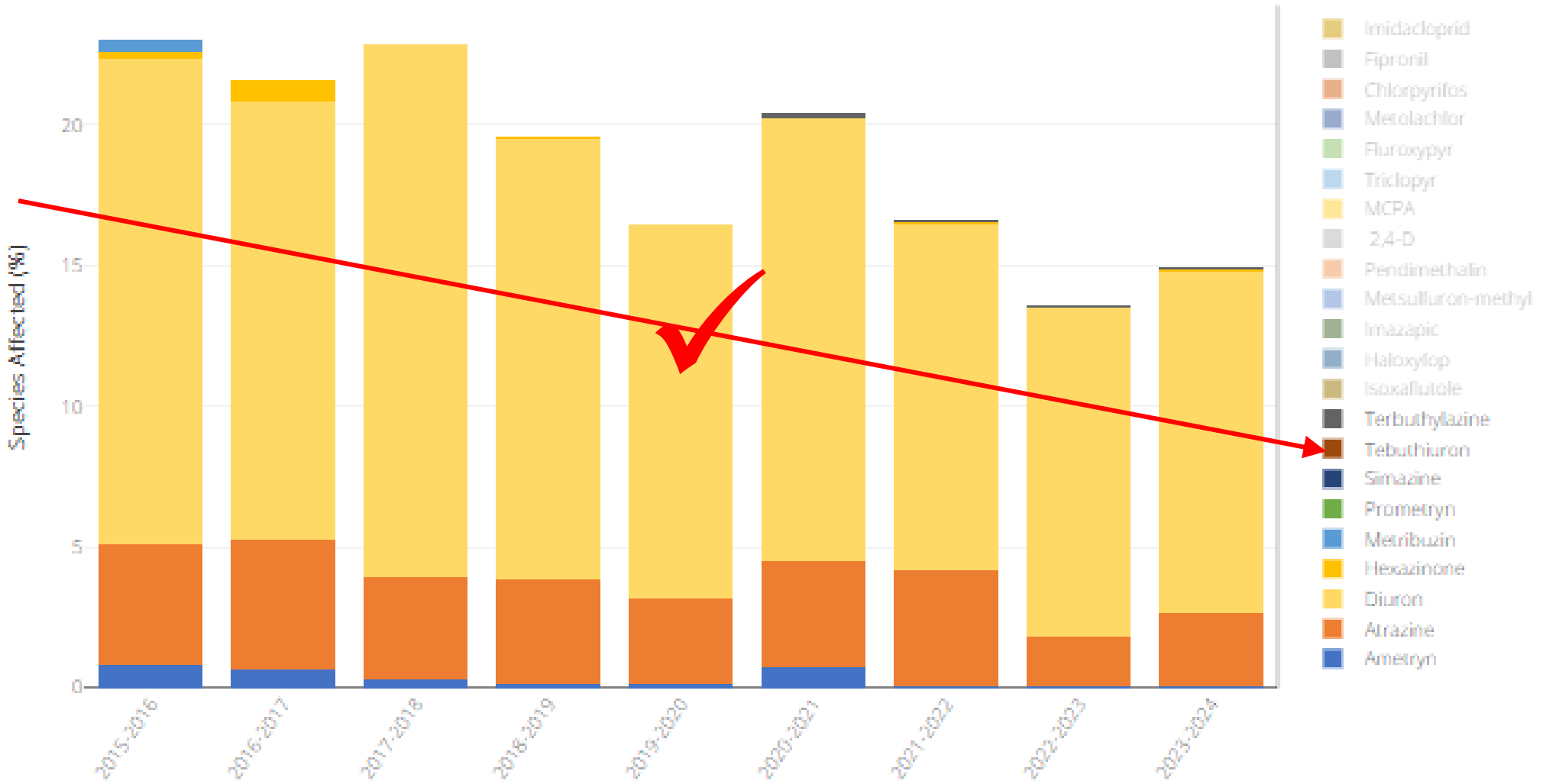
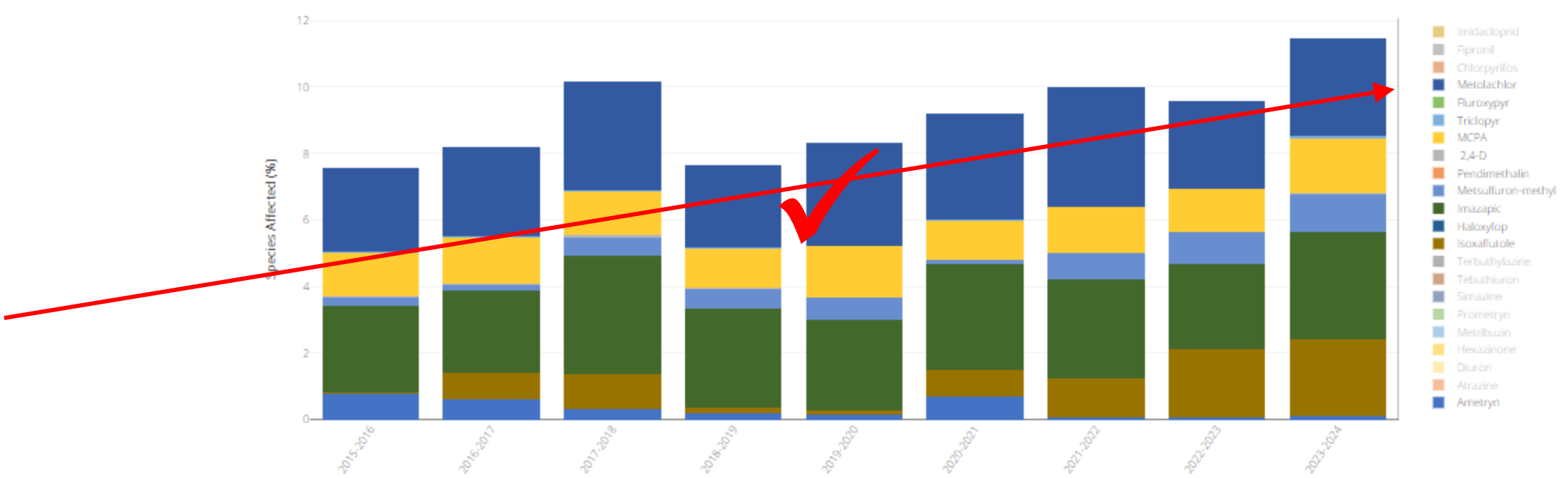
PSII Herbicides in Sandy Creek



Sandy Creek at Homebush

CATCHMENT WATER QUALITY ALLIANCE

Other Herbicides in Sandy Creek



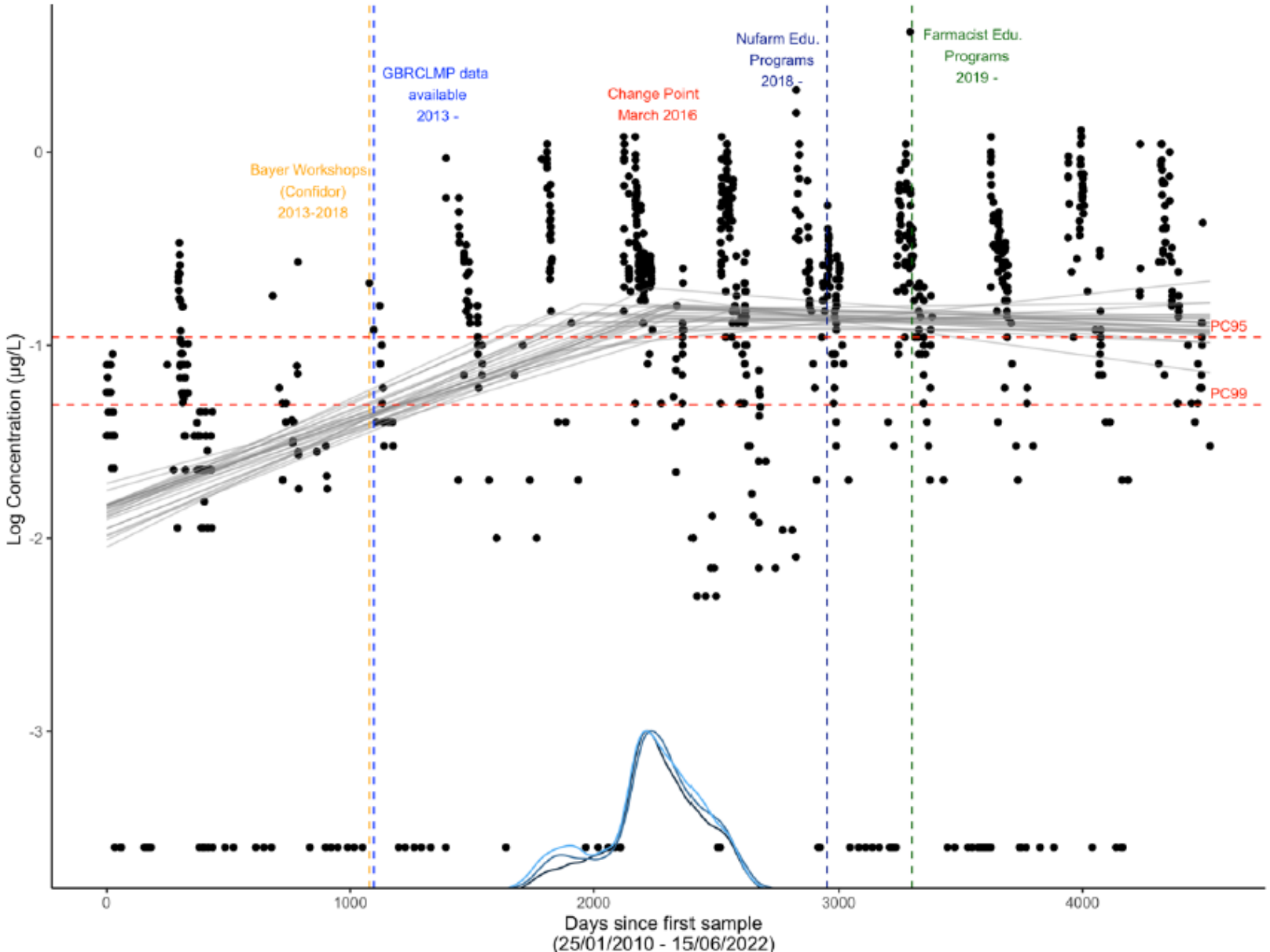
Sandy Creek at Homebush

Over whole time-scale (2011/12 – 2022/23) there is statistically significant increase in other herbicides (P <0.0001)

After the change point (August 2016), there is no statistically significant increase in other herbicides (p = 0.943)

CATCHMENT WATER QUALITY ALLIANCE

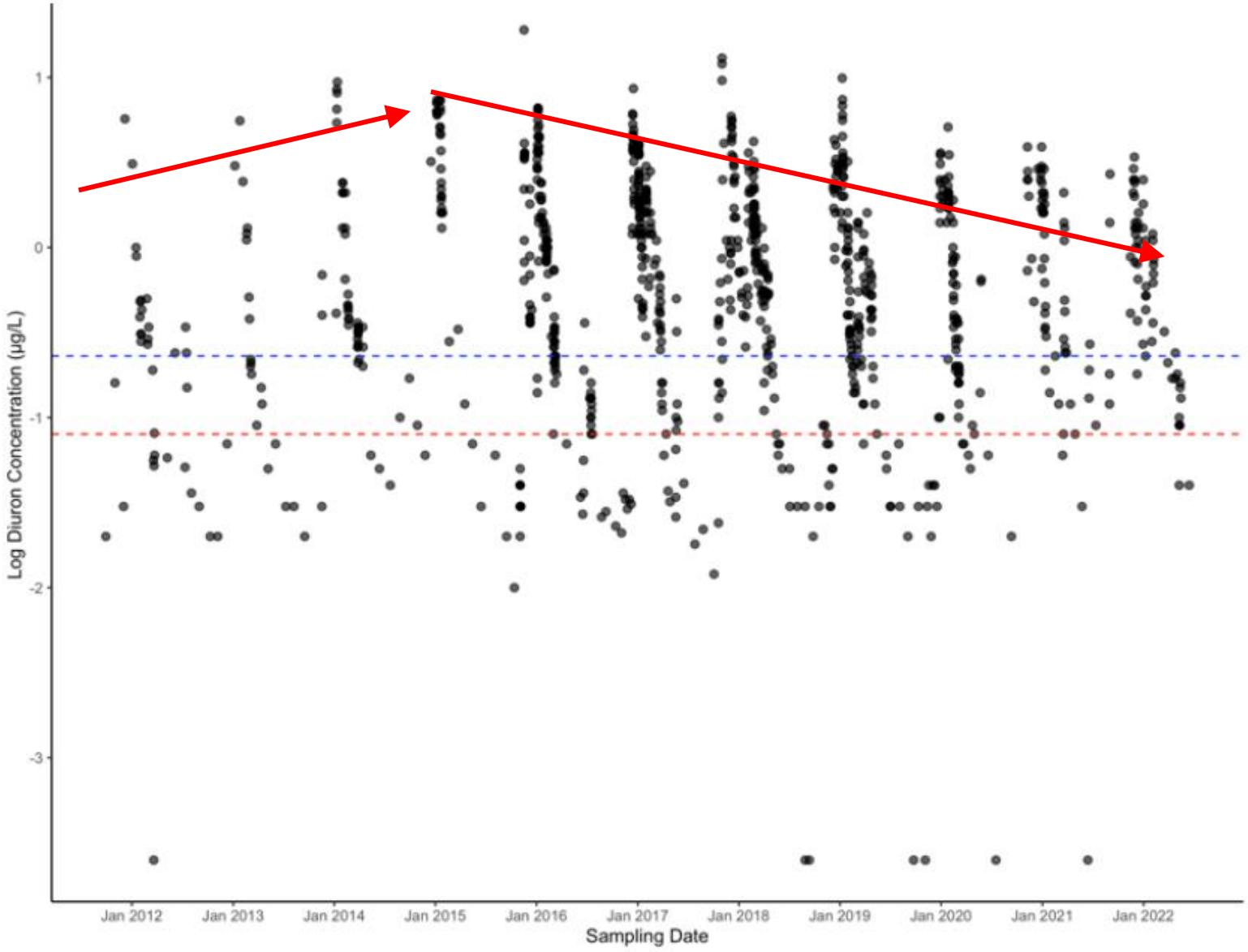
Sandy Creek at Homebush - Imidacloprid



Significant increase ($p < 0.0001$) and then plateau ($p = 0.864$)

Rass, Heinrich (2023). *Are Pesticides Concentrations Increasing or Decreasing in Waterways that Discharge to the Great Barrier Reef Lagoon?*. Honours Thesis, Reef Catchments Science Partnership, The University of Queensland. https://doi.org/10.14264/a362448

Sandy Creek at Homebush - Diuron



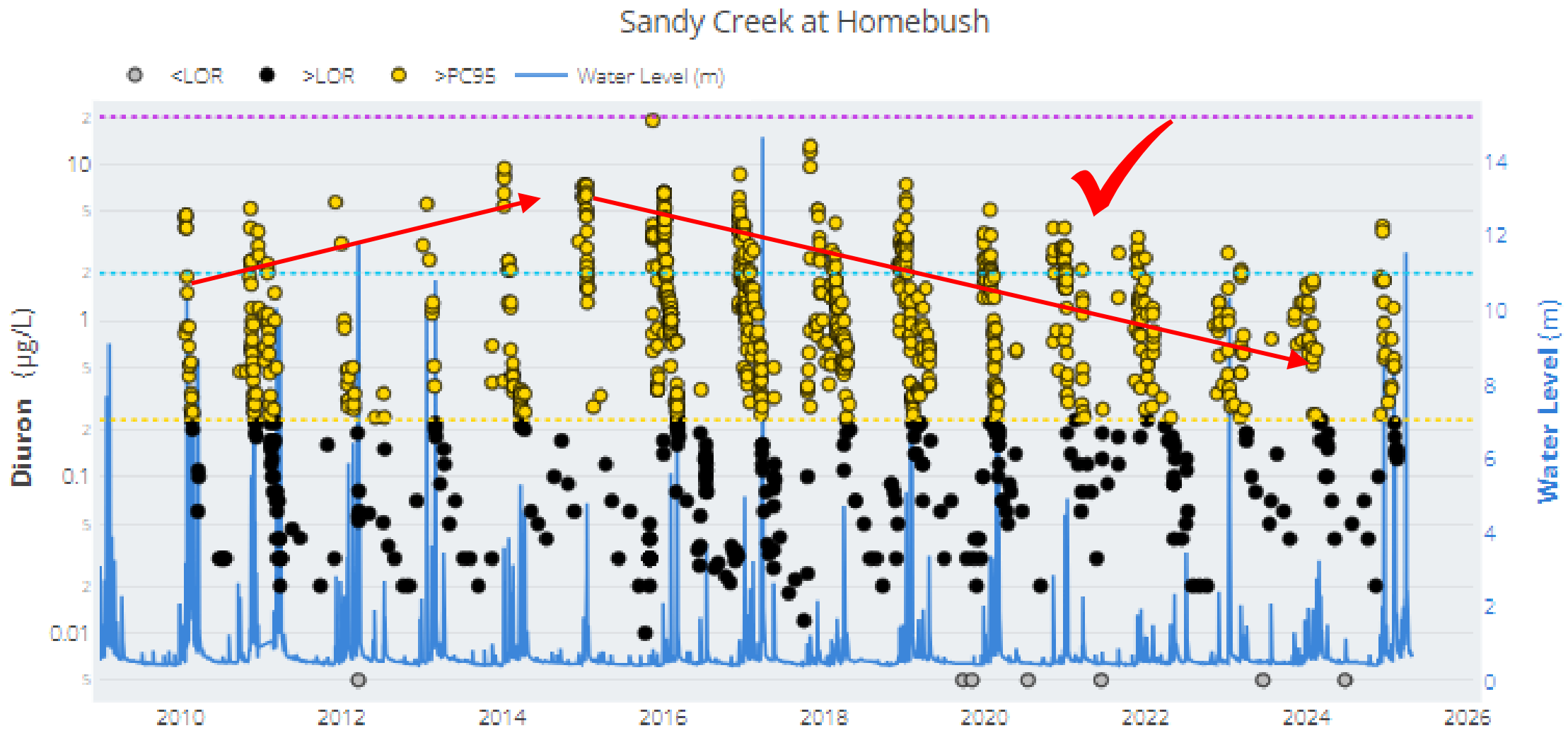
No Change point analysis

No significant trend (p = 0.438) over entire time-scale

Significant decrease from 2015 - 2022 (p = 0.019)
Significant increase from 2011 – 2015 (p = 0.034)

Rass, Heinrich (2023). *Are Pesticides Concentrations Increasing or Decreasing in Waterways that Discharge to the Great Barrier Reef Lagoon?*. Honours Thesis, Reef Catchments Science Partnership, The University of Queensland. https://doi.org/10.14264/a362448

Diuron concentrations in Sandy Creek



Diuron

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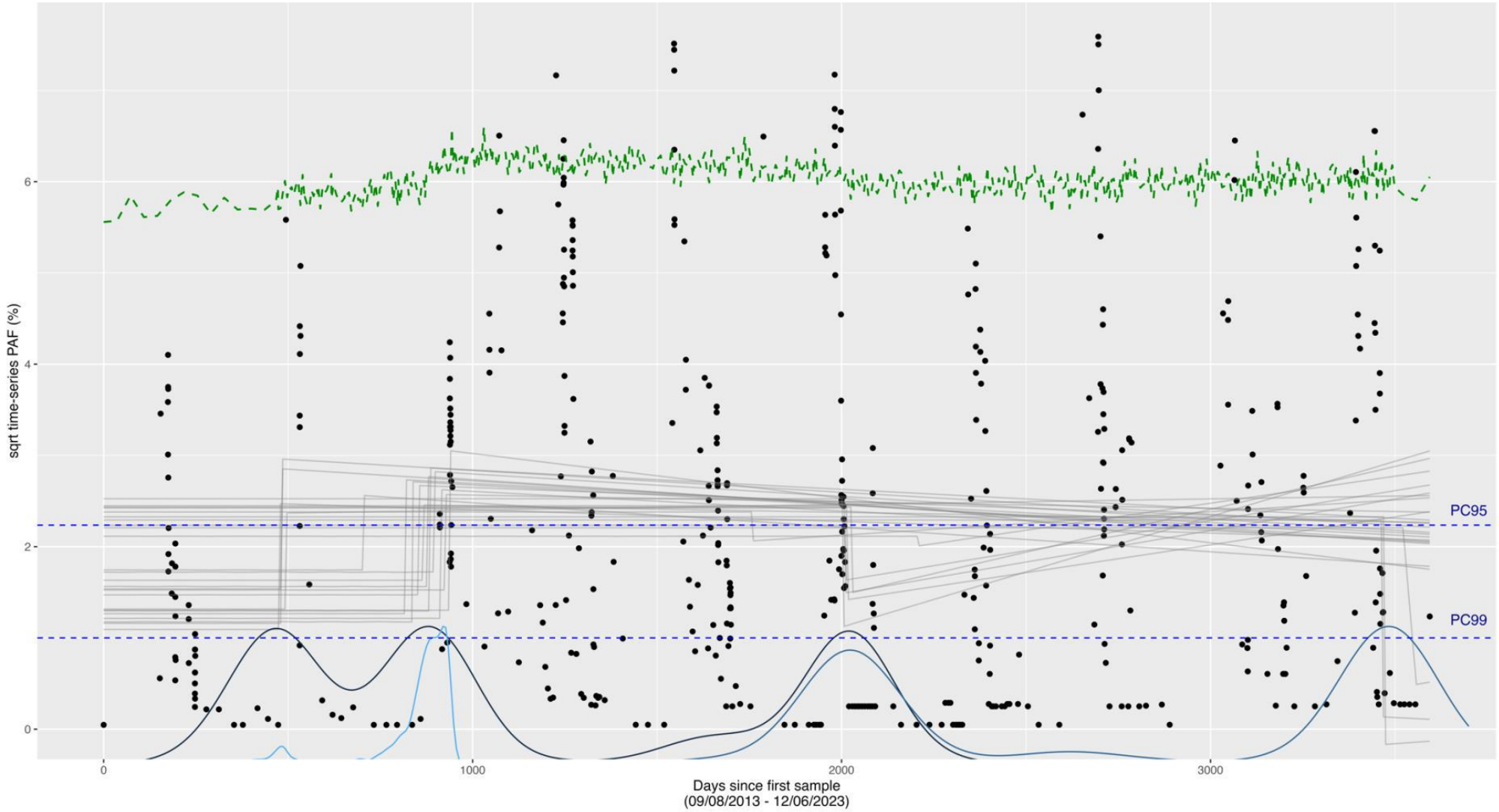
O’Connell River (Caravan Park) – Total Pesticides



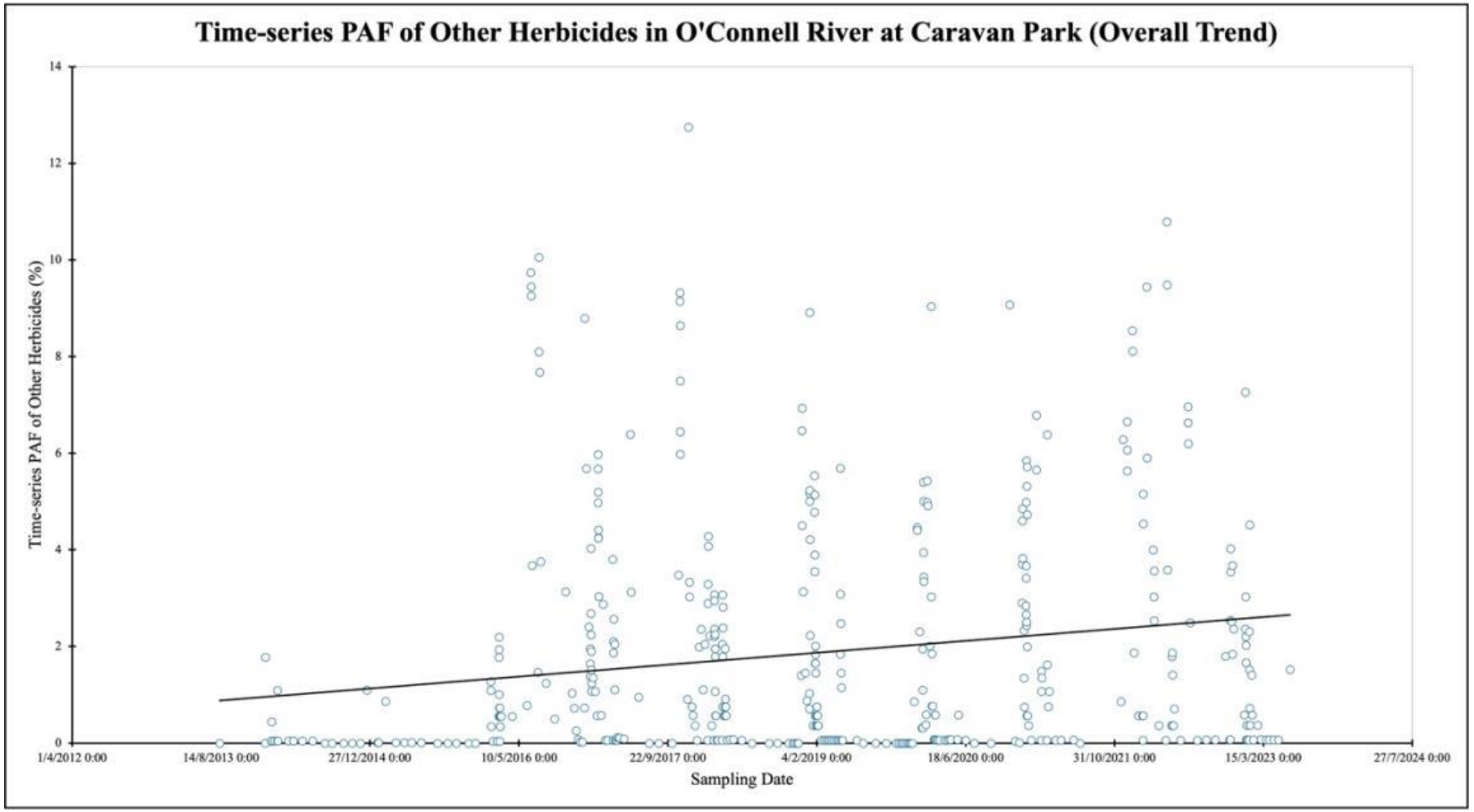
No clear change points

No significant trend for total pesticides (p = 0.992),

PSII herbicides (p = 0.237)
Insecticides (p = 0.243)

Attagad, Nattapat (2024). *Assessing long temporal trends of timeseries Potentially Affected Fraction (PAF) on the Great Barrier Reef rivers.* Honours Thesis, School of the Environment, The University of Queensland. https://doi.org/10.14264/2da064b

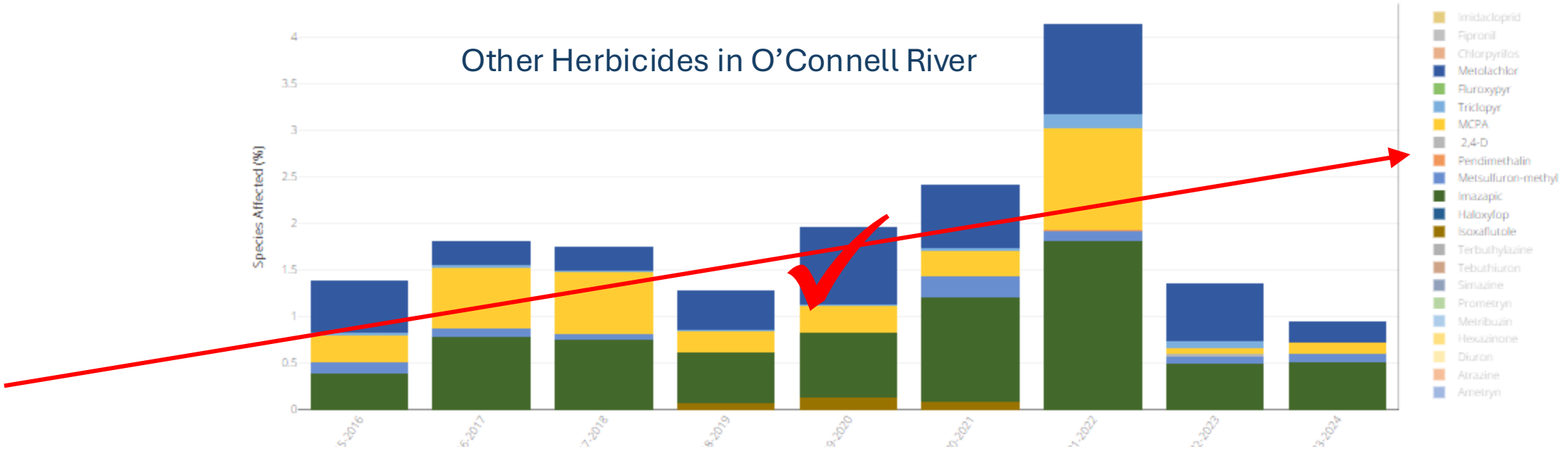
O’Connell River (Caravan Park) – Other Herbicides



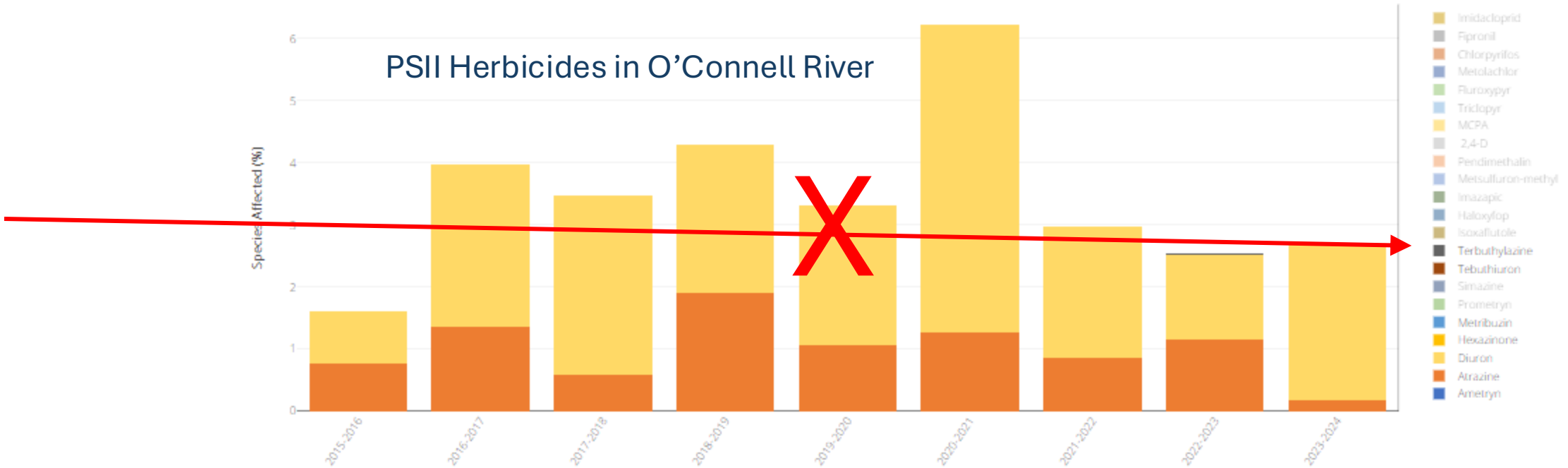
Other Herbicides - Statistically significant increasing trend (p = 0.001).

Attagad, Nattapat (2024). *Assessing long temporal trends of timeseries Potentially Affected Fraction (PAF) on the Great Barrier Reef rivers.* Honours Thesis, School of the Environment, The University of Queensland. https://doi.org/10.14264/2da064b

Other Herbicides in O'Connell River



PSII Herbicides in O'Connell River



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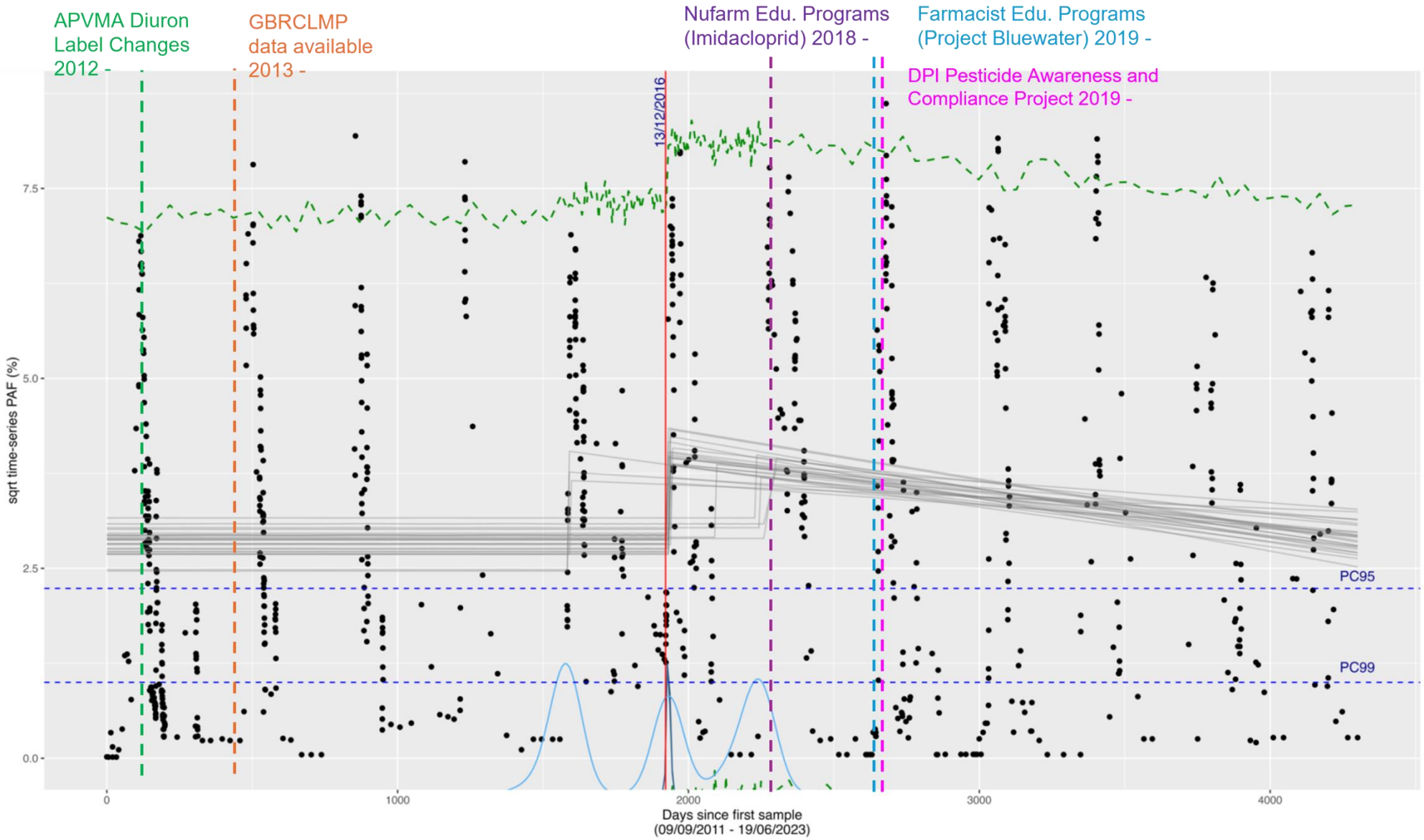
Pioneer River – Total Pesticides



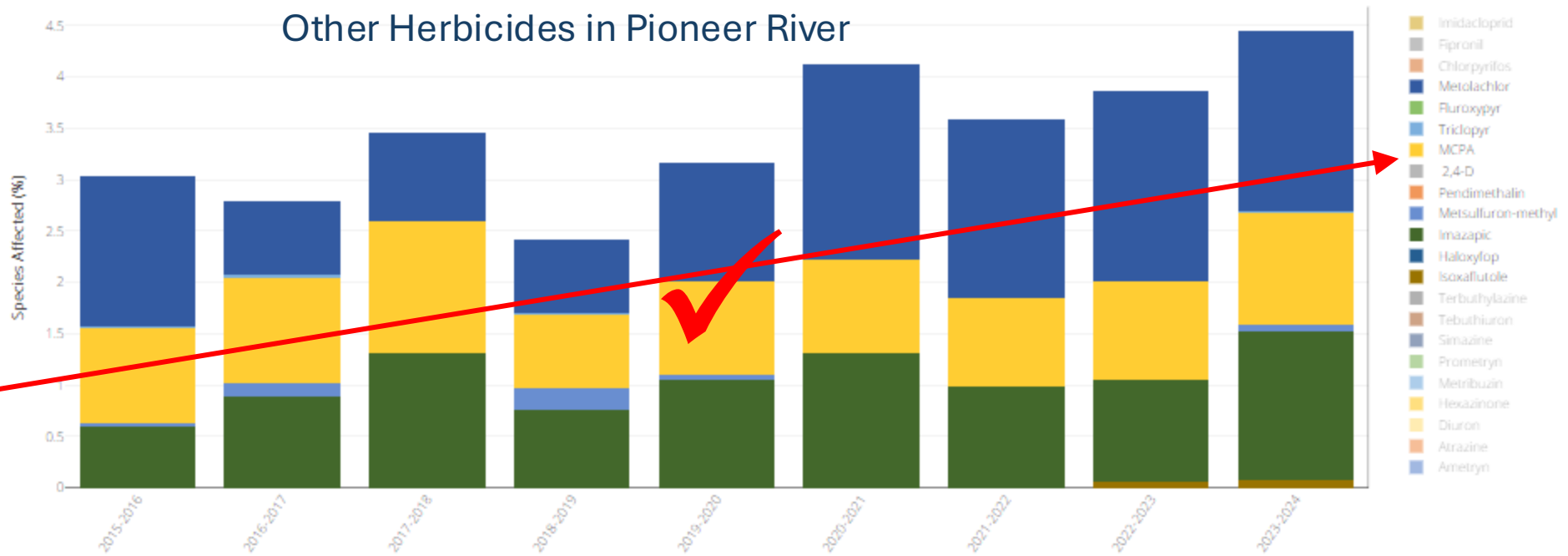
No significant trends for total pesticides (p = 0.225)

PSII herbicides (p = 0.182)
Other Herbicides (p = 0.950)
Insecticides (p = 0.155)

Significant increase in Other herbicides over entire time-scale (p < 0.0001)

Attagad, Nattapat (2024). *Assessing long temporal trends of timeseries Potentially Affected Fraction (PAF) on the Great Barrier Reef rivers.* Honours Thesis, School of the Environment, The University of Queensland. https://doi.org/10.14264/2da064b

Other Herbicides in Pioneer River



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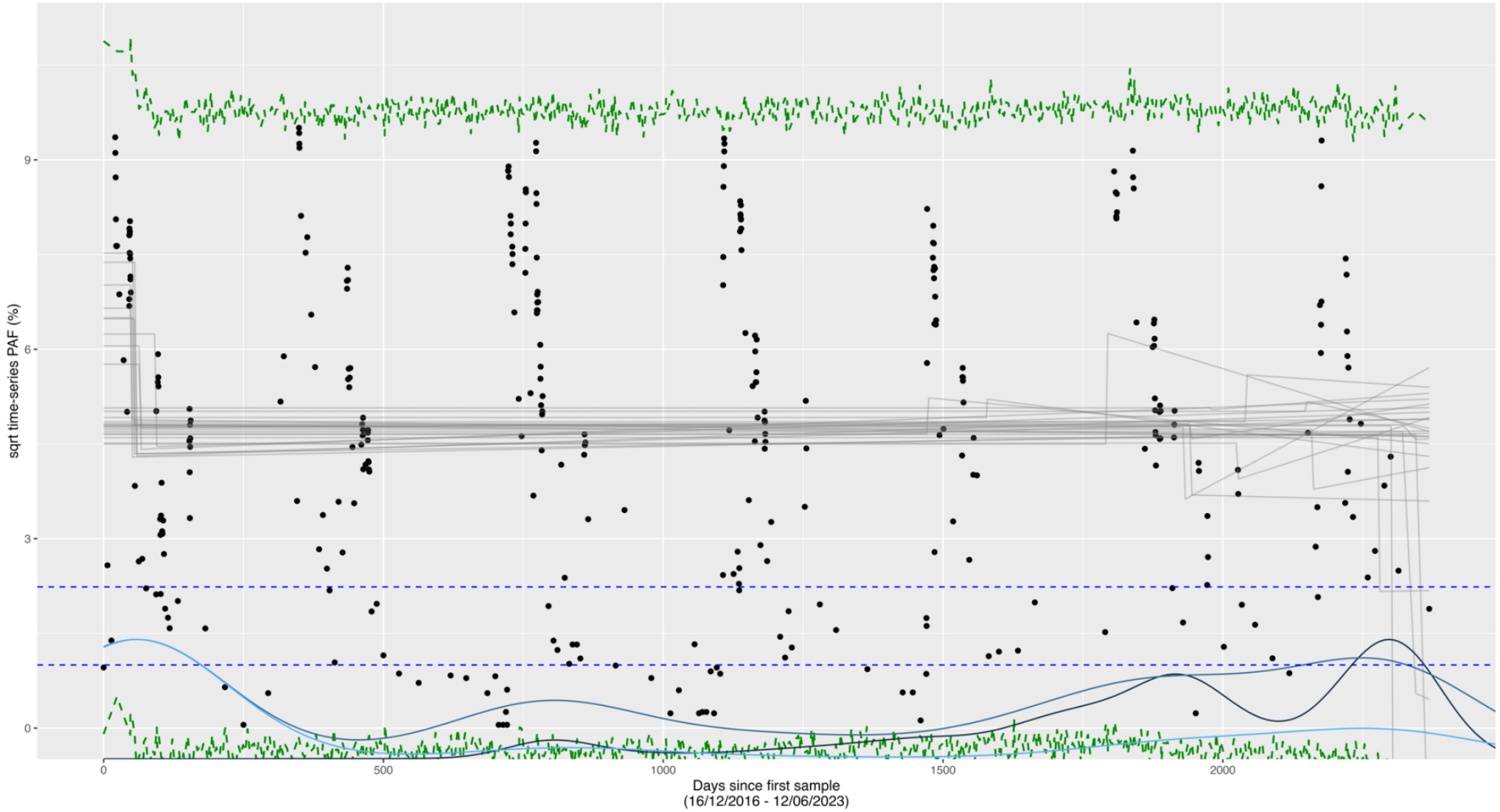
Proserpine River – Total Pesticides



No significant trends

Attagad, Nattapat (2024). *Assessing long temporal trends of timeseries Potentially Affected Fraction (PAF) on the Great Barrier Reef rivers*. Honours Thesis, School of the Environment, The University of Queensland. https://doi.org/10.14264/2da064b

Summary

- Intensive education and extension programs in Sandy Creek catchment has seen a decrease in the losses of PSII (diuron) from farms and a stabilisation of imidacloprid losses and therefore an overall reduction in risk.
- Where extension is less prevalent (e.g. Proserpine River catchment), no change in risk can be found.
- Increases in Other herbicides (i.e. in Sandy Creek, Pioneer and O'Connell catchments) suggests that the message about swapping PSII for alternatives has received traction.
- In Mackay Whitsunday, other herbicides present a toxicity risk in themselves, and choosing chemicals with lower risk needs to go hand in hand with practices that reduce application (e.g. as advocated by Project Bluewater)

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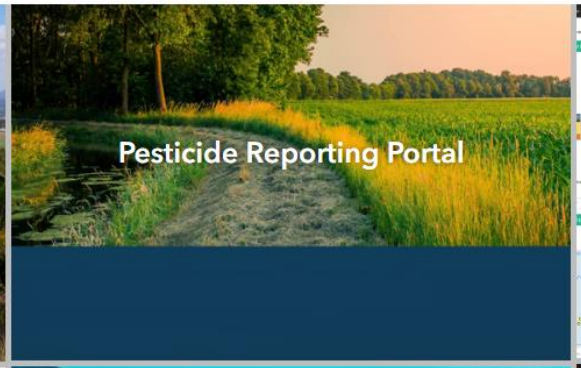

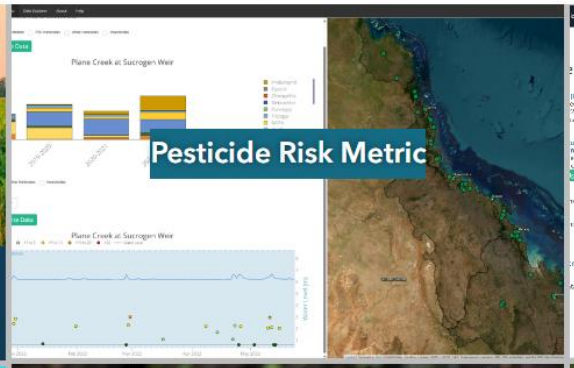

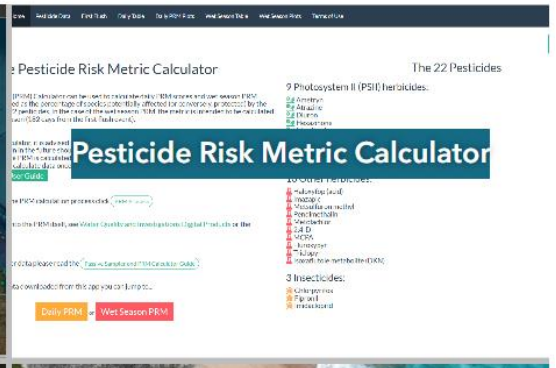

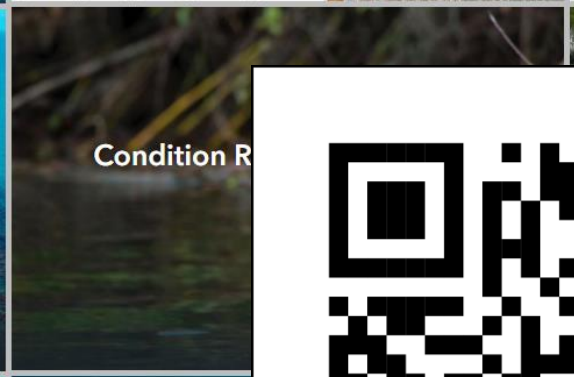

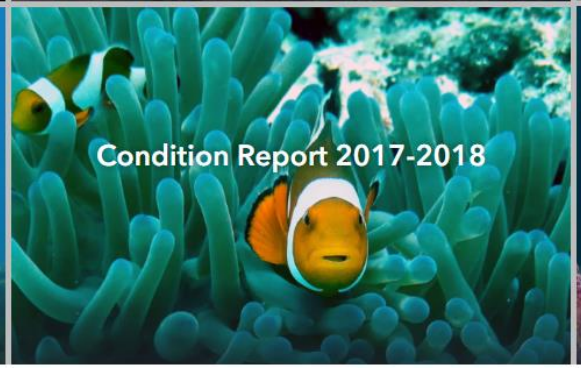

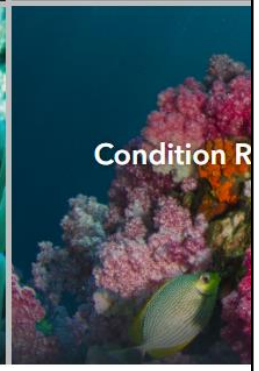

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Email: reinier.mann@des.qld.gov.au

Extra slides

Appendix C. A Summary of SMK Tables

Table C1. A summary of SMK assessing overall trends of every group of pesticide mixtures in 13 monitoring sites. All yellow-highlighted cells indicate significant trends (when the p-value is less than 0.01). Kendall's tau indicates the strength and direction of the trends; positive tau is an increasing trend while negative one is a decreasing trend.

Site Name	Total Pesticides		PSII		Insecticides		Other Herbicides	
	Kendall's tau	P-value	Kendall's tau	P-value	P-value	Kendall's tau	Kendall's tau	P-value
Barratta Creek at Northcote	0.030	0.567	-0.030	0.569	0.008	0.855	0.206	**<0.0001**
Burdekin River at Home Hill Inkerman Bridge	0.087	0.142	0.038	0.490	0.431	**<0.0001**	0.197	**0.002**
Comet River at Comet Weir	0.001	0.996	-0.072	0.366	0.480	**<0.0001**	0.061	0.435
Herbert River at John Row Bridge	0.134	**0.001**	0.085	**0.036**	0.216	**<0.0001**	0.359	**<0.0001**
Johnstone River at Coquette Point	-0.157	**0.002**	-0.056	0.265	-0.221	**<0.0001**	-0.054	0.335
Mulgrave River at Deeral	-0.087	0.061	-0.132	**0.006**	-0.078	0.110	-0.044	0.348
North Johnstone River at Goondi	-0.272	**<0.0001**	-0.154	**0.014**	-0.281	**<0.0001**	0.120	0.153
O'Connell River at Caravan Park	-0.001	0.992	-0.065	0.237	-0.065	0.243	0.189	**0.001**
Pioneer River at Dumbleton Pump Station Headwater	0.079	0.115	-0.008	0.874	0.279	**<0.0001**	0.336	**<0.0001**
Proserpine River at Glen Isla	-0.040	0.552	-0.056	0.437	-0.059	0.378	0.015	0.820
Russell River at East Russell	-0.147	**0.002**	-0.139	**0.005**	-0.297	**<0.0001**	-0.035	0.406
Sandy Creek at Homebush	0.029	0.556	-0.032	0.176	0.094	0.053	0.200	**<0.0001**
Tully River at Euramo	-0.025	0.541	0.064	0.120	-0.224	**<0.0001**	0.113	**0.005**

CATCHMENT WATER QUALITY ALLIANCE

Table C2. A summary of SMK assessing the trends before change point according to the location of change point in total pesticides (output from CPA). All yellow-highlighted cells indicate significant trends (when the p-value is less than 0.01). Kendall's tau (Tau in this table) indicates the strength and direction of the trends; positive tau is an increasing trend and vice versa.

Site Name	SMK Before the Change Point							
	Total Pesticides Tau	Total Pesticides P-value	PSII Tau	PSII P-value	Insecticide Tau	Insecticide P-value	Other Herbicide Tau	Other Herbicide P-value
Barratta Creek at Northcote	-0.019	0.765	-0.095	0.128	0.108	**0.030**	0.201	**0.001**
Burdekin River at Home Hill Inkerman Bridge	0.059	0.363	-0.083	0.216	0.480	**<0.0001**	0.161	**0.029**
Comet River at Comet Weir	0.030	0.815	0.018	0.900	0.614	**0.003**	0.065	0.579
Herbert River at John Row Bridge	0.069	0.409	-0.039	0.652	0.244	**0.019**	0.219	**0.039**
Johnstone River at Coquette Point	0.158	0.107	0.157	0.112	0.176	0.087	0.405	**0.002**
Mulgrave River at Deeral	0.123	0.120	0.067	0.416	0.144	0.062	0.178	**0.035**
North Johnstone River at Goondi	0.070	0.546	-0.002	1.000	0.053	0.645	0.711	**<0.0001**
O'Connell River at Caravan Park	0.152	0.092	0.022	0.796	0.142	0.132	0.428	**0.000**
Pioneer River at Dumbleton Pump Station Headwater	0.106	0.144	0.005	0.951	0.458	**<0.0001**	0.419	**<0.0001**
Proserpine River at Glen Isla	-0.051	0.566	-0.062	0.516	-0.053	0.536	-0.069	0.435
Russell River at East Russell	0.068	0.323	-0.021	0.760	0.191	**0.002**	0.221	**0.001**
Sandy Creek at Homebush	0.095	0.293	-0.013	0.891	0.231	**0.011**	0.344	**0.000**
Tully River at Euramo	0.133	**0.026**	0.084	0.166	0.162	**0.011**	0.222	**0.000**

CATCHMENT WATER QUALITY ALLIANCE

Table C3. A summary of SMK assessing the trends after change point according to the location of change point in total pesticides (output from CPA). All yellow-highlighted cells indicate significant trends (when the p-value is less than 0.01). Kendall's tau (Tau in this table) indicates the strength and direction of the trends; positive tau is an increasing trend and vice versa. ND or no trend detections is due to some sequences in the data are constant, so the test cannot be computed.

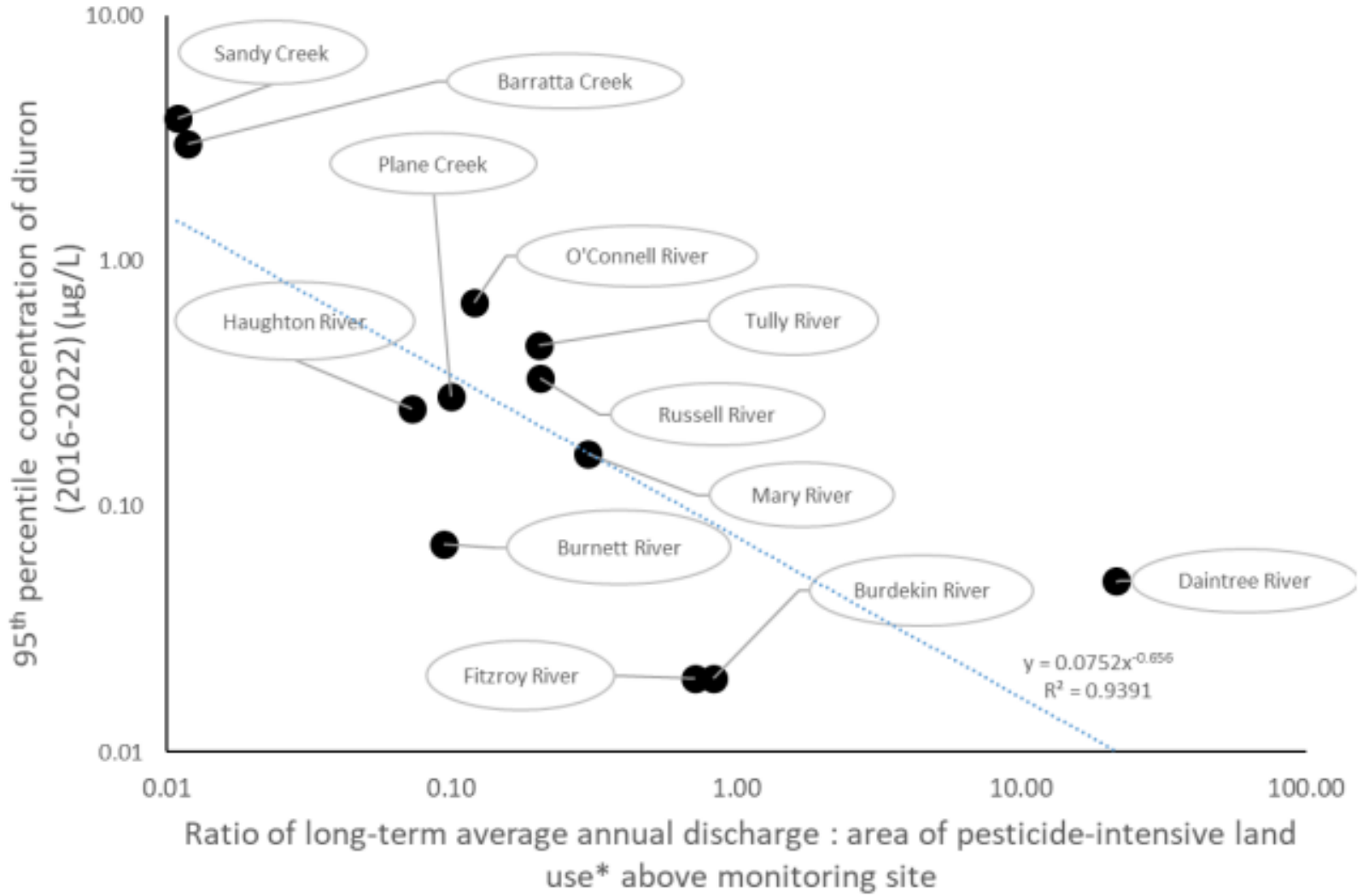
Site Name	SMK After the Change Point							
	Total Pesticides Tau	Total Pesticides P-value	PSII Tau	PSII P-value	Insecticide Tau	Insecticide P-value	Other Herbicide Tau	Other Herbicide P-value
Barratta Creek at Northcote	-0.091	0.382	-0.104	0.314	-0.134	0.238	0.020	0.825
Burdekin River at Home Hill Inkerman Bridge	0.455	**0.001**	0.389	**0.001**	ND		0.460	**0.001**
Comet River at Comet Weir	0.385	**0.000**	0.291	**0.008**			0.401	**0.000**
Herbert River at John Row Bridge	0.046	0.324	0.099	**0.037**	-0.098	**0.048**	0.137	**0.005**
Johnstone River at Coquette Point	-0.179	**0.004**	-0.082	0.188	-0.264	**0.000**	-0.155	**0.017**
Mulgrave River at Deeral	-0.154	**0.009**	-0.137	**0.028**	-0.225	**0.001**	-0.230	**0.000**
North Johnstone River at Goondi	-0.359	**<0.0001**	-0.243	**0.002**	-0.401	**<0.0001**	-0.229	**0.028**
O'Connell River at Caravan Park	0.048	0.517	-0.014	0.864	-0.029	0.700	0.089	0.209
Pioneer River at Dumbleton Pump Station Headwater	-0.089	0.225	-0.099	0.182	-0.104	0.155	-0.004	0.950
Proserpine River at Glen Isla	-0.032	0.818	0.009	0.954	-0.059	0.700	0.056	0.607
Russell River at East Russell	-0.054	0.411	-0.017	0.817	-0.374	**<0.0001**	0.070	0.229
Sandy Creek at Homebush	-0.105	0.085	-0.144	**0.021**	-0.031	0.601	0.004	0.943
Tully River at Euramo	-0.094	0.109	0.023	0.693	-0.473	**<0.0001**	0.031	0.623

CATCHMENT WATER QUALITY ALLIANCE

Table C1. Extended Seasonal Mann-Kendall statistics for diuron concentrations. Values in bold indicate statistical significance (P=0.05)

SITE	Start date (mm/dd/YYYY)	Trend - Tau (significance)	2013 -	2014 -	2015 -	2011-2013	2011-2015	2013-2015
Tully River	24/2/2011	0.055 (0.208)	0.14 (0.763)		-0.37 (0.463)	-0.230 (0.074)	0.94 (0.252)	
Sandy Creek	29/9/2011	-0.038 (0.438)	-0.078 (0.123)		**-0.123 (0.019)**	0 (0)	**0.275 (0.034)**	**0.263 (0.047)**
Russell River	23/1/2014	**-0.108 (0.042)**		**-0.108 (0.042)**				
Proserpine River	16/12/2016	-0.040 (0.605)						
Plane Creek	30/1/2017	**-0.247 (0.029)**						
Pioneer River	15/9/2011	-0.010 (0.843)	-0.093 (0.1)		-0.08 (0.234)	-0.126 (0.232)	0.050 (0.550)	
O'Connell River (Staffords Crossing)	26/9/2016	**-0.169 (0.022)**						
O'Connell River (Caravan Park)	9/8/2013	-0.102 (0.097)	-0.102 (0.097)		-0.113 (0.101			
Barratta River	1/8/2011	-0.069 (0.207)	0.077 (0.205		-0.001 (0.987	-0.441 (0.004)	-0.010 (0.926	

CATCHMENT WATER QUALITY ALLIANCE

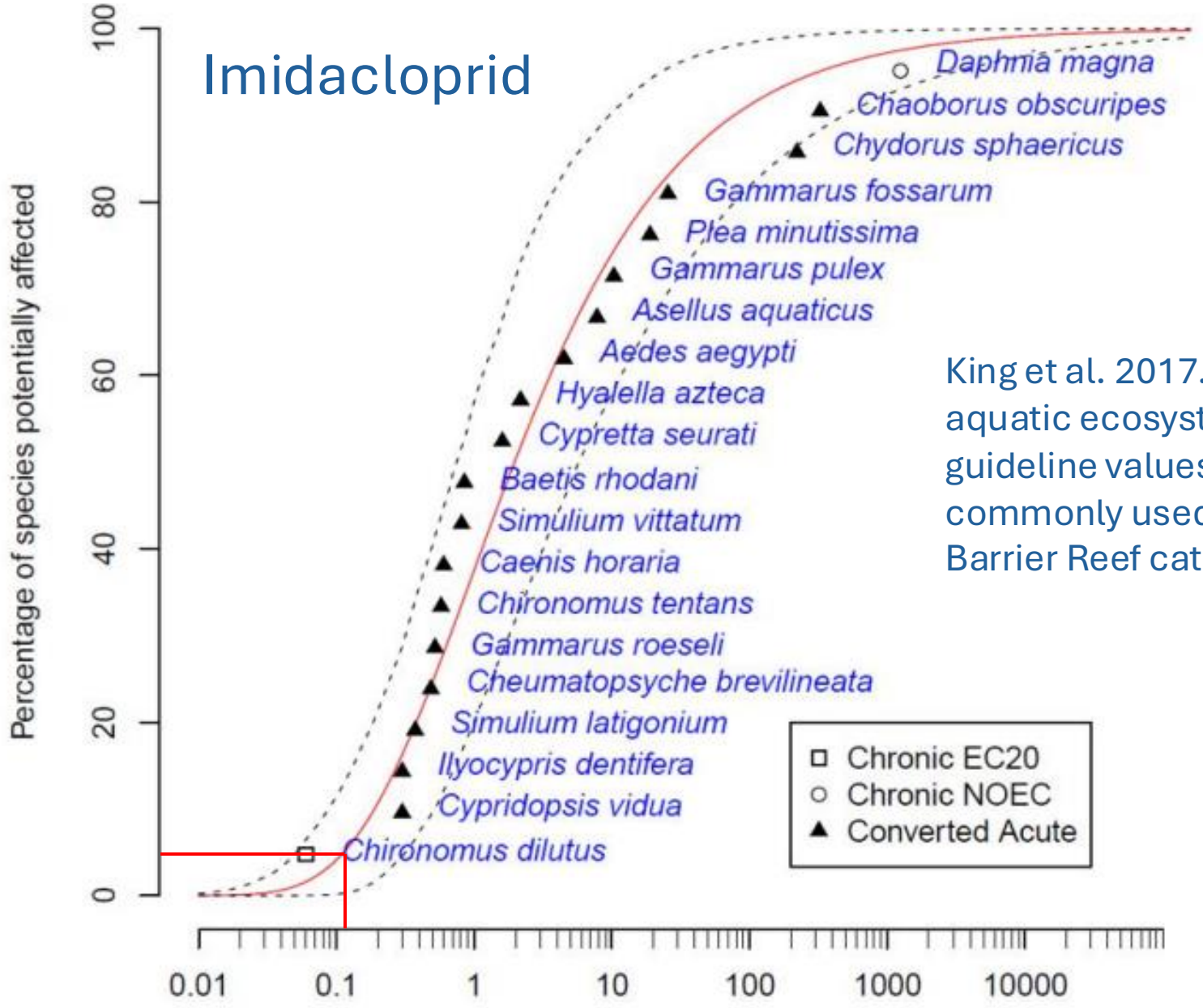


Negri AP, Taucare G, Neale P, Neelamraju C, Kaminski H, Mann RM, Warne M St J (2024) Question 5.1 What is the spatial and temporal distribution of pesticides across Great Barrier Reef ecosystems? What are the (potential or observed) ecological impacts in these ecosystems? What evidence is there for pesticide risk? In Waterhouse J, Pineda M-C, Sambrook K (Eds) 2022 Scientific Consensus Statement on land-based impacts on Great Barrier Reef water quality and ecosystem condition. Commonwealth of Australia and Queensland Government.

CATCHMENT WATER QUALITY ALLIANCE

Pesticide Guidelines for protection of ecosystems

Imidacloprid



King et al. 2017. Part 1—Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area

CATCHMENT WATER QUALITY ALLIANCE

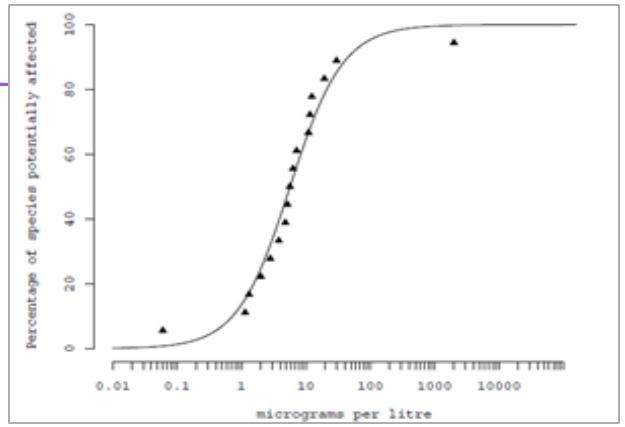
Wet season average Pesticide Risk Metric (PRM)

Independent Action (IA) model of joint toxicity

$$PAF_{IA_{RA}} = 1 - \prod_{i} (1 - PAF_i)$$

Toxic effects are added together using this formula

for i = 1 to n substances, with PAF_{RA} representing the msPAF of various compounds calculated by response addition assuming $r = 0$.



PAF_{IA} = 1 – (1-$PAF_{Ametryn}$) x (1-PAF_{Diuron}) x (1-$PAF_{Imidacloprid}$)…

PAF_{IA} = 1 – (1-0.05) x (1-0.336)

= 0.371

= 37.1% species affected

0.336 = 33.6% species affected

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Ecotoxicity threshold values for 4-hydroxychlorothalonil, carbendazim, dimethoate and methoxyfenozide in fresh and marine waters: Part 1. Derivation of threshold values

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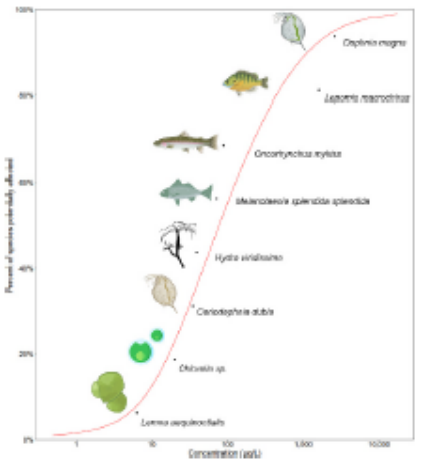
HIGHLIGHTS

- Pesticides pose a hazard to aquatic ecosystems of the Great Barrier Reef.
- Ecotoxicity threshold values derived for three pesticides and a pesticide degradate.
- Used nationally endorsed method and species sensitivity distribution approach.
- The threshold values should protect 99, 95, 90 and 80 % of aquatic species.
- Values can be compared to monitoring data to assess hazard to aquatic ecosystems.

GRAPHICAL ABSTRACT



The expanded Pesticide Risk Metric

PSII herbicide	Other Herbicide	Insecticide	Fungicide
Ametryn	**2,4-D**	**Chlorpyrifos**	*4-Hydroxy Chlorothalonil*
Amicarbazone	Acifluorfen	Acetamiprid	Carbendazim
Atrazine	Flumetsulam	Bifenthrin	Epoxiconazole
Bromacil	Flumioxazin	Chlorantraniliprole	Flutriafol
Diuron	**Fluroxypyr**	Clothianidin	Mancozeb
Fluometuron	Glyphosate	Diazinon	Propiconazole
Hexazinone	Halosulfuron-methyl	Dimethoate	
Metribuzin	**Haloxyfop (acid)**	Dinotefuran	
Prometryn	Imazamox	**Fipronil**	
Simazine	**Imazapic**	Flupyradifurone	
Tebuthiuron	***Isoxaflutole metabolite (DKN)***	**Imidacloprid**	
Terbuthylazine	**MCPA**	Methomyl	
	Metolachlor	Methoxyfenozide	
	Metsulfuron methyl	Spinetoram	
	Paraquat	Tetraniliprole	
	Pendimethalin	Thiacloprid	
	Picloram	Thiamethoxam	
	Triclopyr		

CATCHMENT WATER QUALITY ALLIANCE

Changes to the PM

- The new PRM is applicable to a broader range of land uses, both in Australia and overseas
- The number and type of pesticides detected at a site will depend on upstream land use
- For the 22 pesticides with revised SSDs, our understanding of toxicity has improved
- Where possible, data for local species like corals has been added (e.g. NESP project)
- Therefore, the revised risk metric is more relevant to the waters we need to protect

Name of pesticide	Ms-PAF category	Prev PC95 (µg/L)	New PC95 (µg/L)	Toxicity
Chlorpyrifos	Insecticide	0.016	0.018	⇨
Fipronil	Insecticide	0.01	0.01	⇨
Imidacloprid	Insecticide	0.13	0.008	↑
Haloxyfop	Other Herbicide	1969	124	↑
Imazapic	Other Herbicide	0.44	2.0	↓
Metsulfuron-methyl	Other Herbicide	0.033	0.015	↑
Pendimethalin	Other Herbicide	0.27	0.25	⇨
Metolachlor	Other Herbicide	0.4	0.25	↑
2,4-D	Other Herbicide	17	71	↓
MCPA	Other Herbicide	1.5	11.3	↓
Fluroxypyr	Other Herbicide	275	301	↓
Triclopyr	Other Herbicide	4.2	7.03	↓
Isoxaflutole	Other Herbicide	0.69	0.68	⇨
Ametryn	PSII Herbicide	0.36	0.36	⇨
Atrazine	PSII Herbicide	1.2	4.7	↓
Prometryn	PSII Herbicide	0.43	0.5	↓
Terbuthylazine	PSII Herbicide	1.4	1.4	⇨
Tebuthiuron	PSII Herbicide	11	13	↓
Simazine	PSII Herbicide	33	13	↑
Diuron	PSII Herbicide	0.22	0.44	↓
Hexazinone	PSII Herbicide	2.5	2.5	⇨
Metribuzin	PSII Herbicide	2.6	1.1	↑

CATCHMENT WATER QUALITY ALLIANCE

Acknowledgement of Country

- I would like to acknowledge Aboriginal and Torres Strait Islander peoples as the Traditional Owners and Custodians of the Country on which we meet.
- We recognise their connection to land, sea and community.
- We pay our respects to them, their cultures, and to their Elders, past present and emerging.

CATCHMENT WATER QUALITY ALLIANCE