



# The Potential Effect of Climate Change on Stormwater Treatment

M. Murdock & M. Groves



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**Stormwater 2024**  
15–17 May | Takina Wellington Te Whanganui-a-Tara

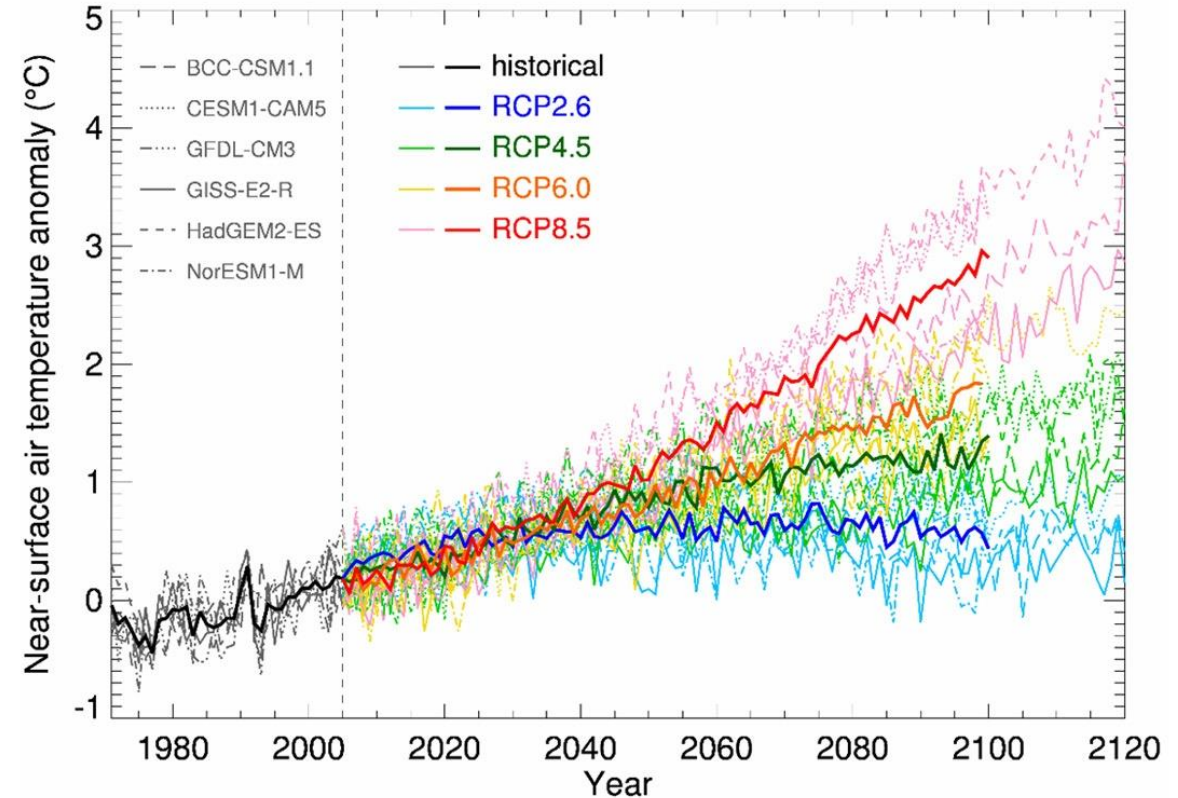
# DO WE NEED TO CHANGE THE WAY WE SIZE STORMWATER TREATMENT SYSTEMS TO ACCOUNT FOR CLIMATE CHANGE?



# WE HAVE ATTEMPTED TO ANSWER THIS QUESTION BY USING:

1 Observed Data

2 Climate Model Projections



# NIWA CLIFLO (OBSERVED DATA)

## Database Query

[Save Settings](#) [Preview](#) [Send Query](#) [?](#)

[logout](#)

Your subscription details: username=mmurdock  
Remaining rows = 904,391

### 1. Datatype

[select datatype\(s\)](#) [?](#)

[last used datatype\(s\)](#) [Manage](#) [?](#)

[Remove All Datatypes](#)

Selected datatype(s):

Specify options:

Remove datatype:

Monthly/Annual Statistics (codes) [?](#)

02



### 2. Location

[choose station\(s\)](#) [?](#) (based on "updated" datatypes above)

[last used station\(s\)](#) [Manage](#) [?](#)

Station agent number(s):

5814

### 3. Date/time

[?](#)

[last used date](#) [Manage](#) [?](#)

Start date (yyyy):

1996

End date (yyyy):

2024

### 4. Format

[?](#)

[last used format](#) [Manage](#) [?](#)

File download option:

[Excel File](#) [?](#)

Station Identifier:

[Agent Number](#) [?](#)

Data Sort Order

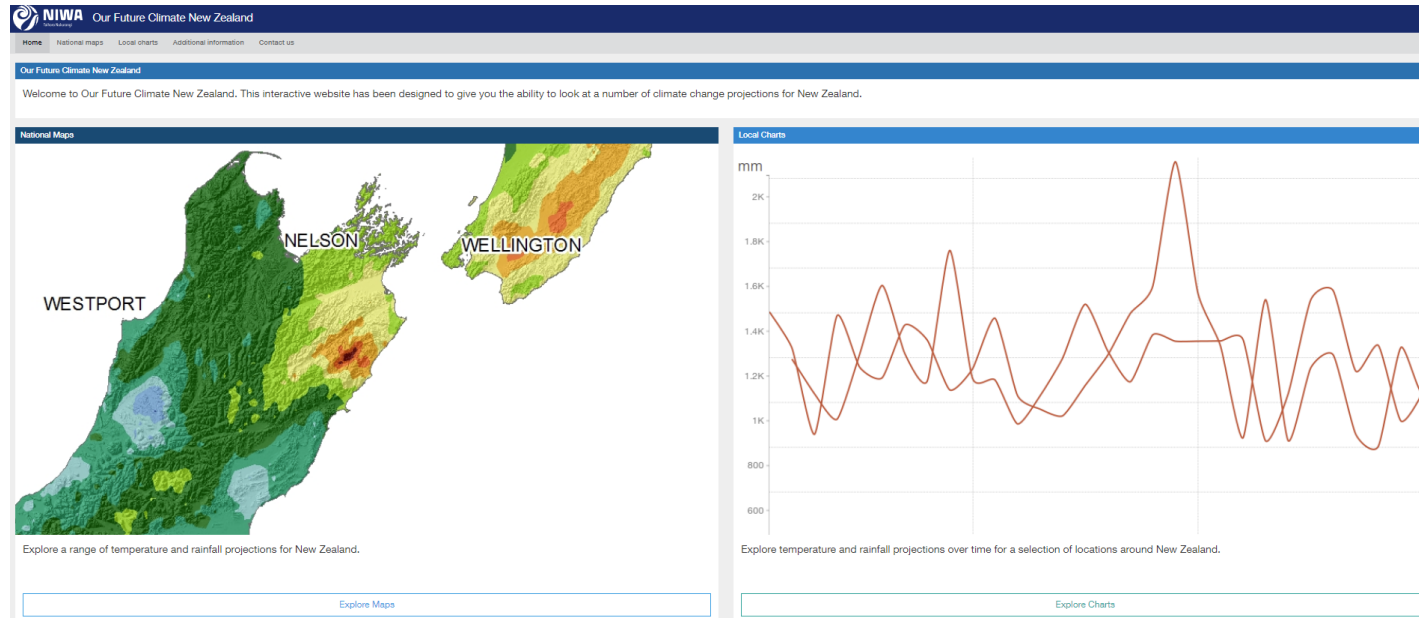
[Date/Station/Code](#) [?](#)

Include reliabilities and origins:

Incl rel  Incl orig [?](#)

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# NIWA 'OUR FUTURE CLIMATE NEW ZEALAND' (CLIMATE MODEL PROJECTIONS)



- Interactive Website
- 6 Global Climate Models
- 4 Relative Concentration Pathways (RCPs)





# EIGHT LOCATIONS

- |   |                                |   |                       |
|---|--------------------------------|---|-----------------------|
| 1 | Whangārei                      | 5 | Christchurch/Ōtautahi |
| 2 | Auckland/Tāmaki Makaurau       | 6 | Queenstown/Tāhuna     |
| 3 | Wellington/Te Whanganui-a-Tara | 7 | Dunedin/Ōtepoti       |
| 4 | Westport/Kawatiri              | 8 | Invercargill/Waihōpa  |

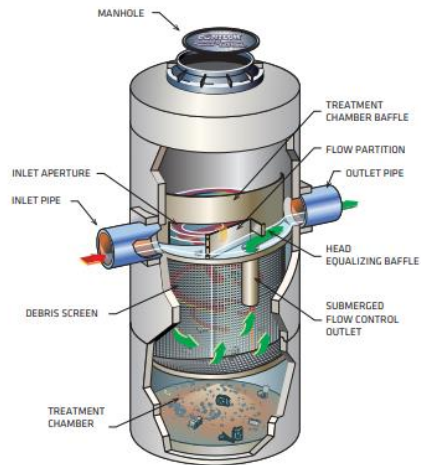
# STORMWATER TREATMENT SYSTEM SIZING



Hoon Hay Basin (Volume Based)

Designed to treat the 'first flush'

- Volume-based systems:
  - Rainfall depth (mm) to calculate a WQV
- Flow-based systems:
  - Rainfall Intensity (mm/hr) to calculate a WQF



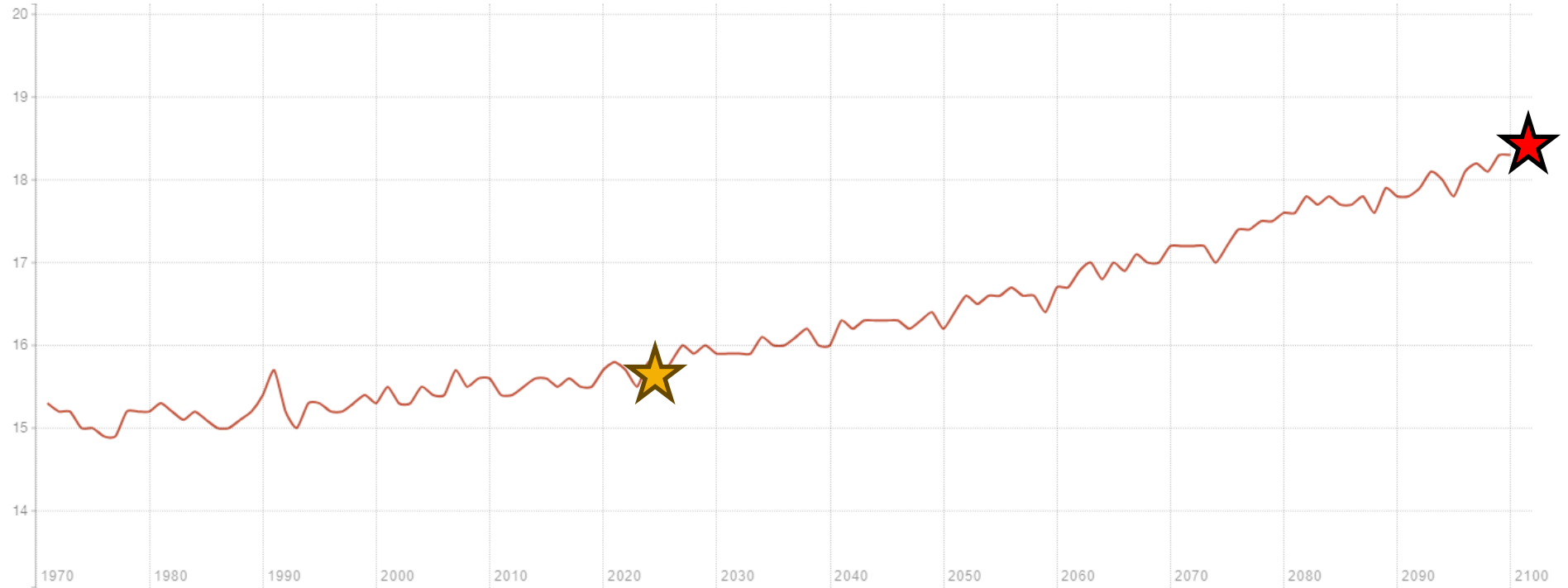
Proprietary Gross Pollutant Trap (Flow Based)

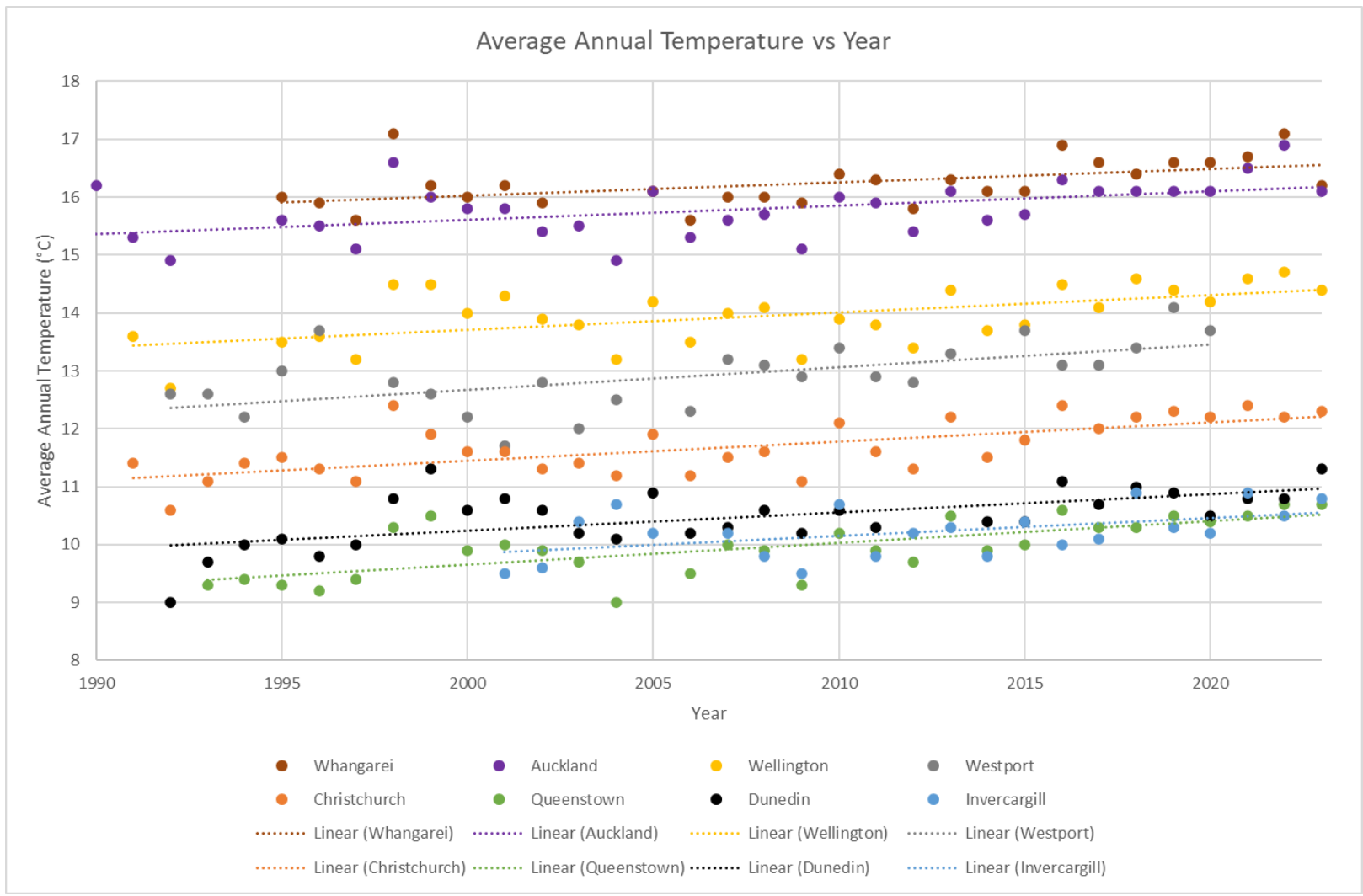
# WHAT ARE THE PREDICTED CONSEQUENCES OF CLIMATE CHANGE?



✓ ■ Six-model-average, RCP8.5 (high)

°C





# HOW MIGHT THIS AFFECT THE WAY WE SIZE STORMWATER TREATMENT SYSTEMS?

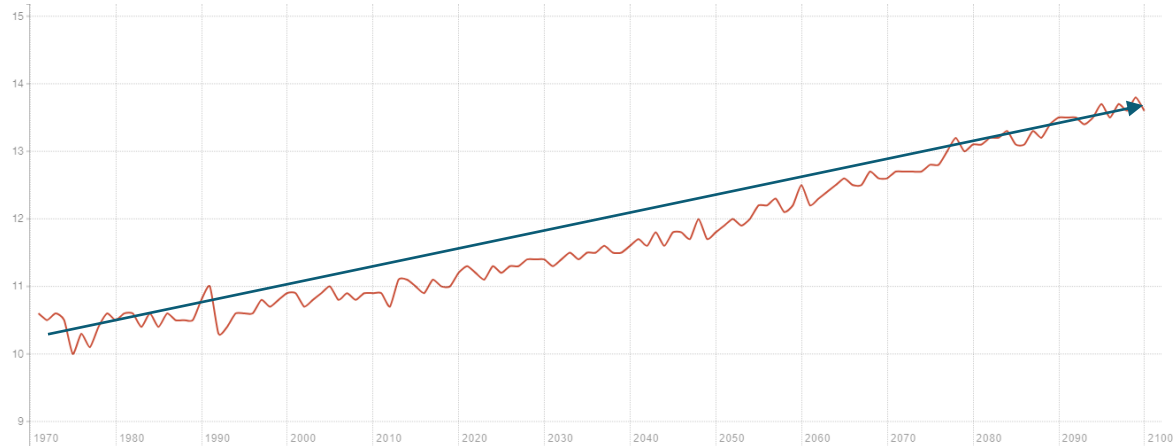
# AVERAGE ANNUAL TEMPERATURE AND ANNUAL RAINFALL

Queenstown, Temperature, Annual

[Download Data](#)

Stk-model-average, RCP8.5 (high)

°C

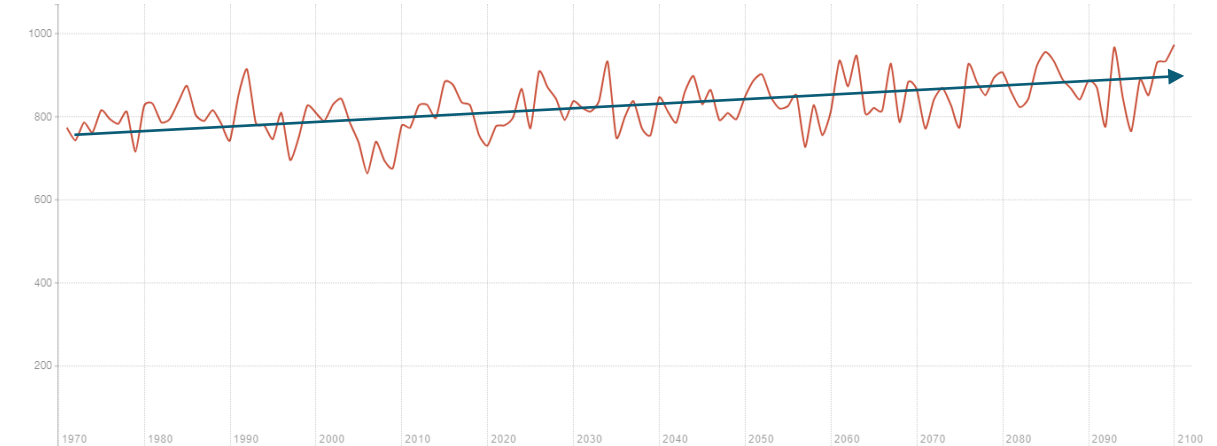


Queenstown, Precipitation, Annual

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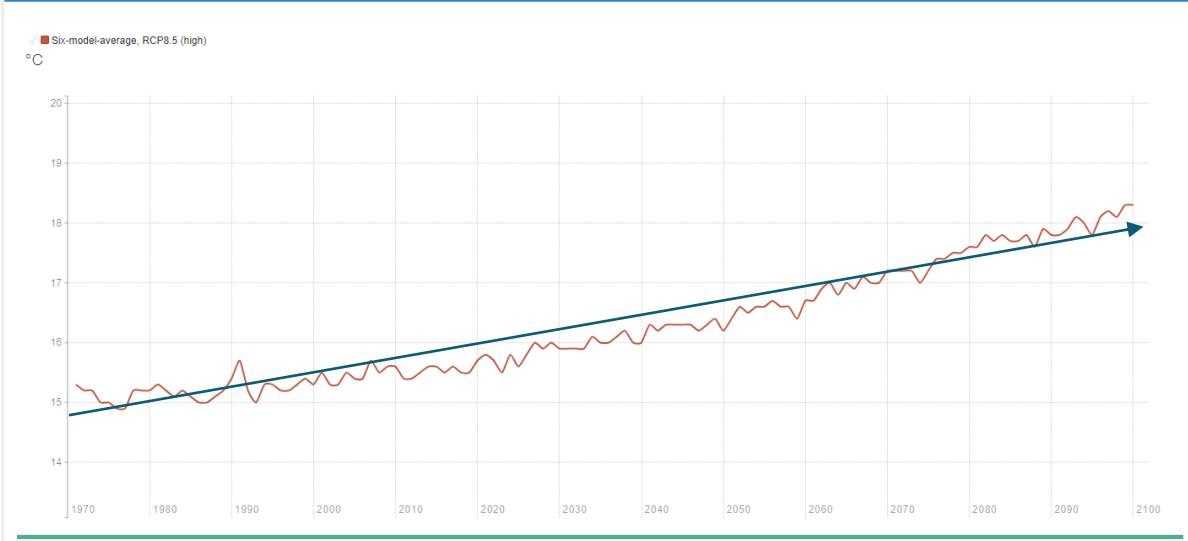
Stk-model-average, RCP8.5 (high)

mm

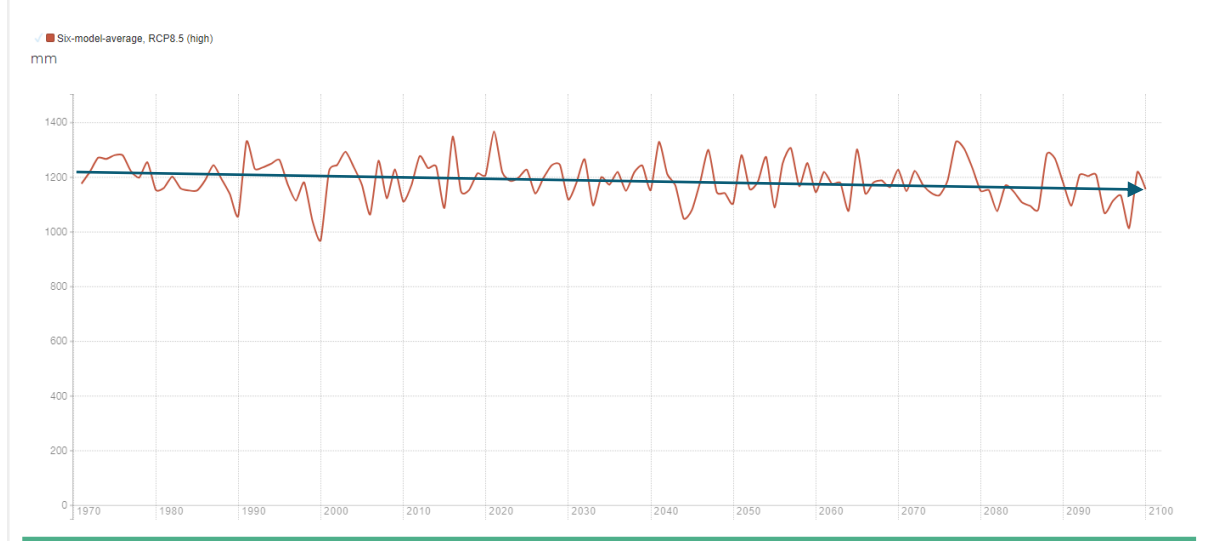


# AVERAGE ANNUAL TEMPERATURE AND ANNUAL RAINFALL

Auckland, Temperature, Annual [Download Data](#)

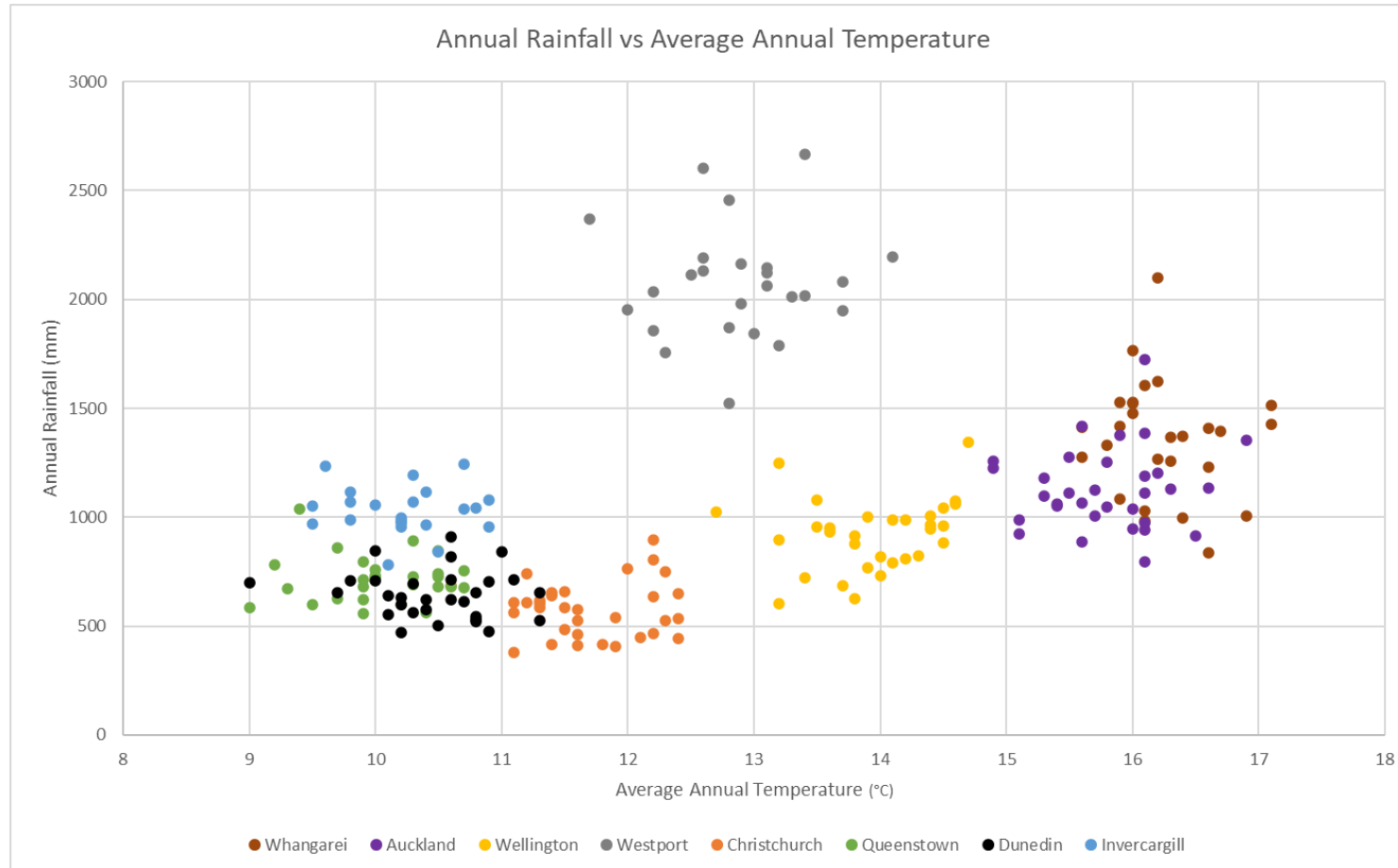


Auckland, Precipitation, Annual [Download Data](#)





# THERE IS NO OBSERVED CORRELATION BETWEEN ANNUAL RAINFALL AND AVERAGE ANNUAL TEMPERATURE

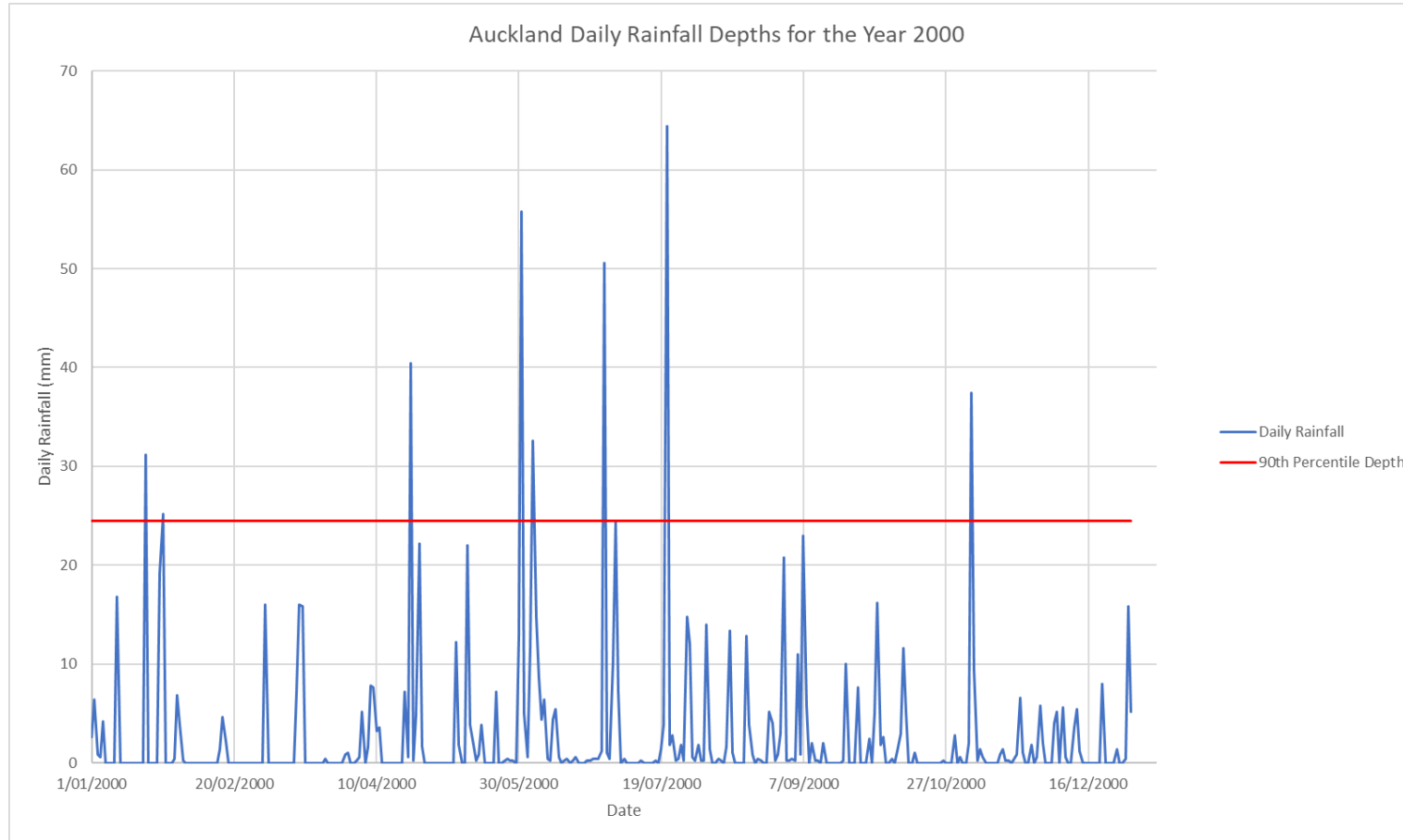


# OTHER POSSIBLE CORRELATIONS

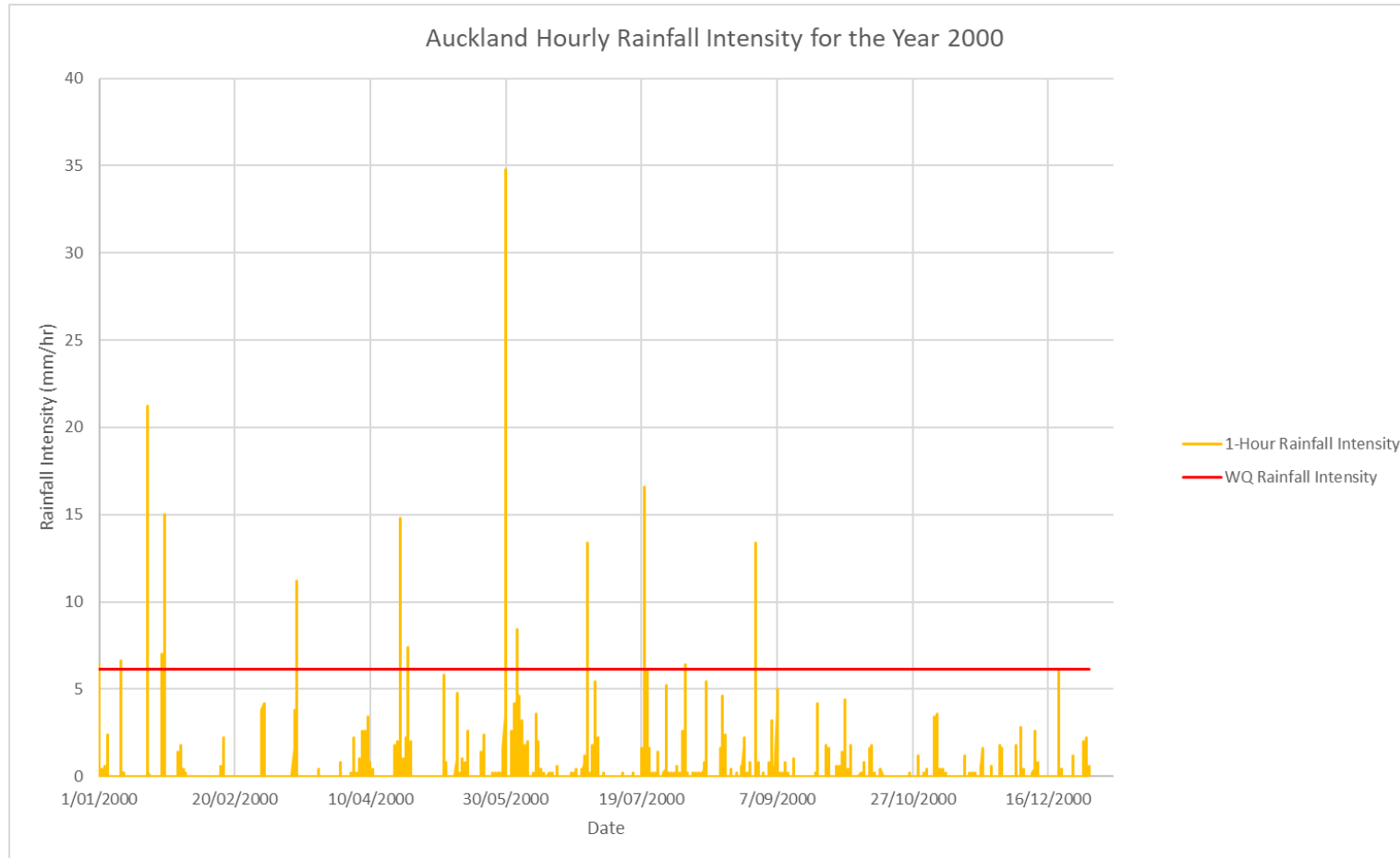
Is there a correlation between:

- Water quality rainfall depth and annual rainfall?
- Water quality rainfall intensity and annual rainfall?

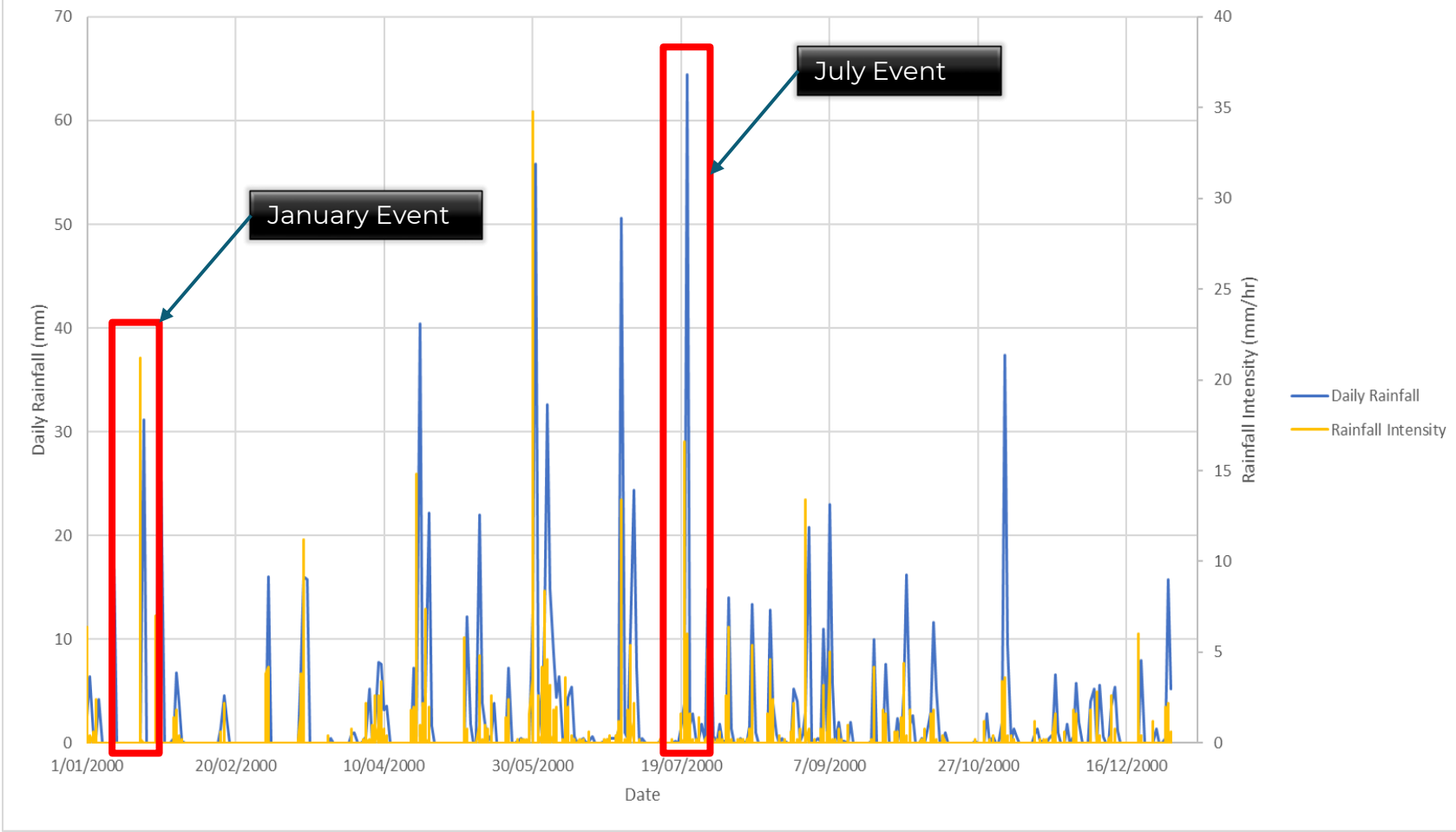
# WATER QUALITY RAINFALL DEPTH



# WATER QUALITY RAINFALL INTENSITY



Auckland Daily Rainfall Depths & Hourly Rainfall Intensity for the Year 2000

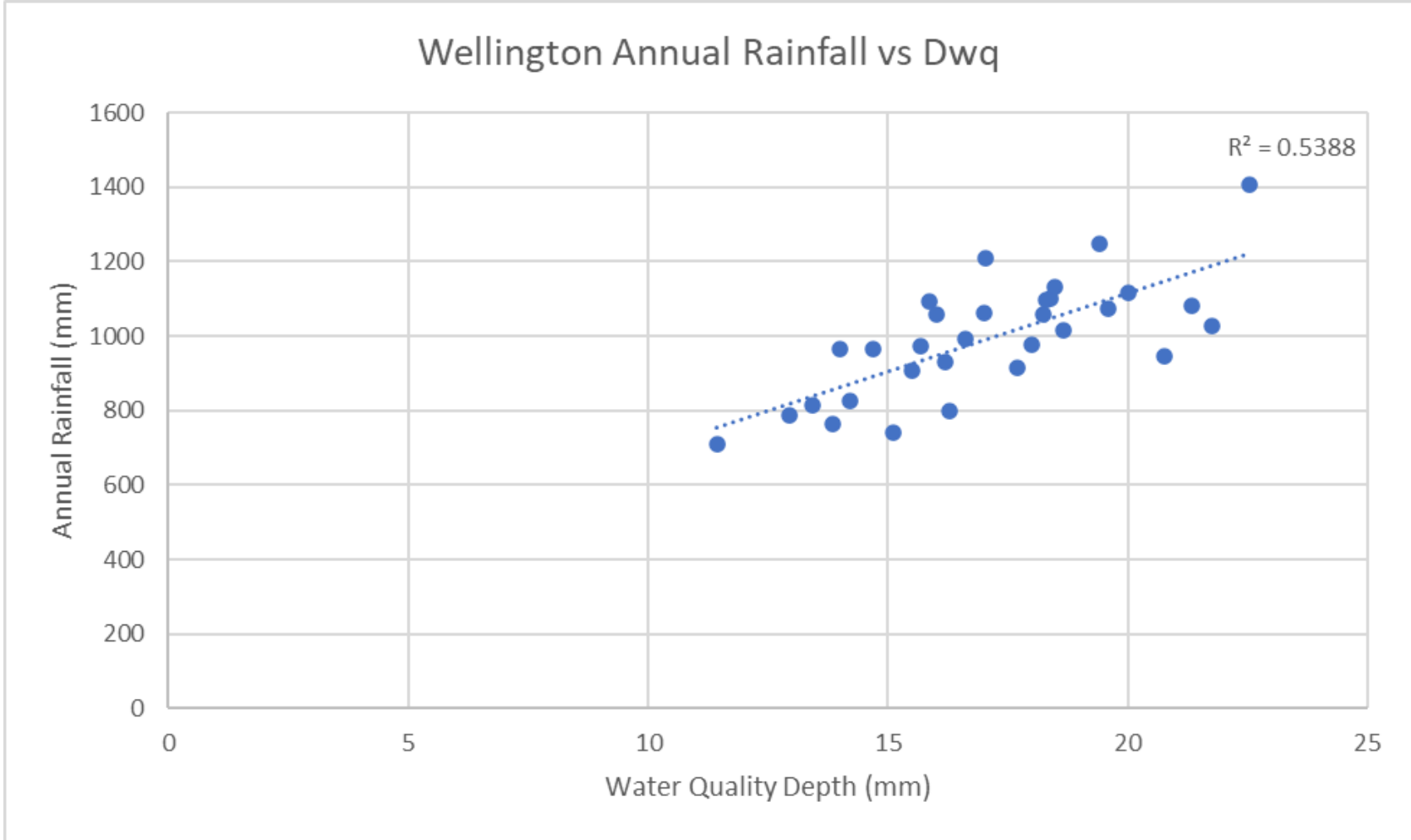




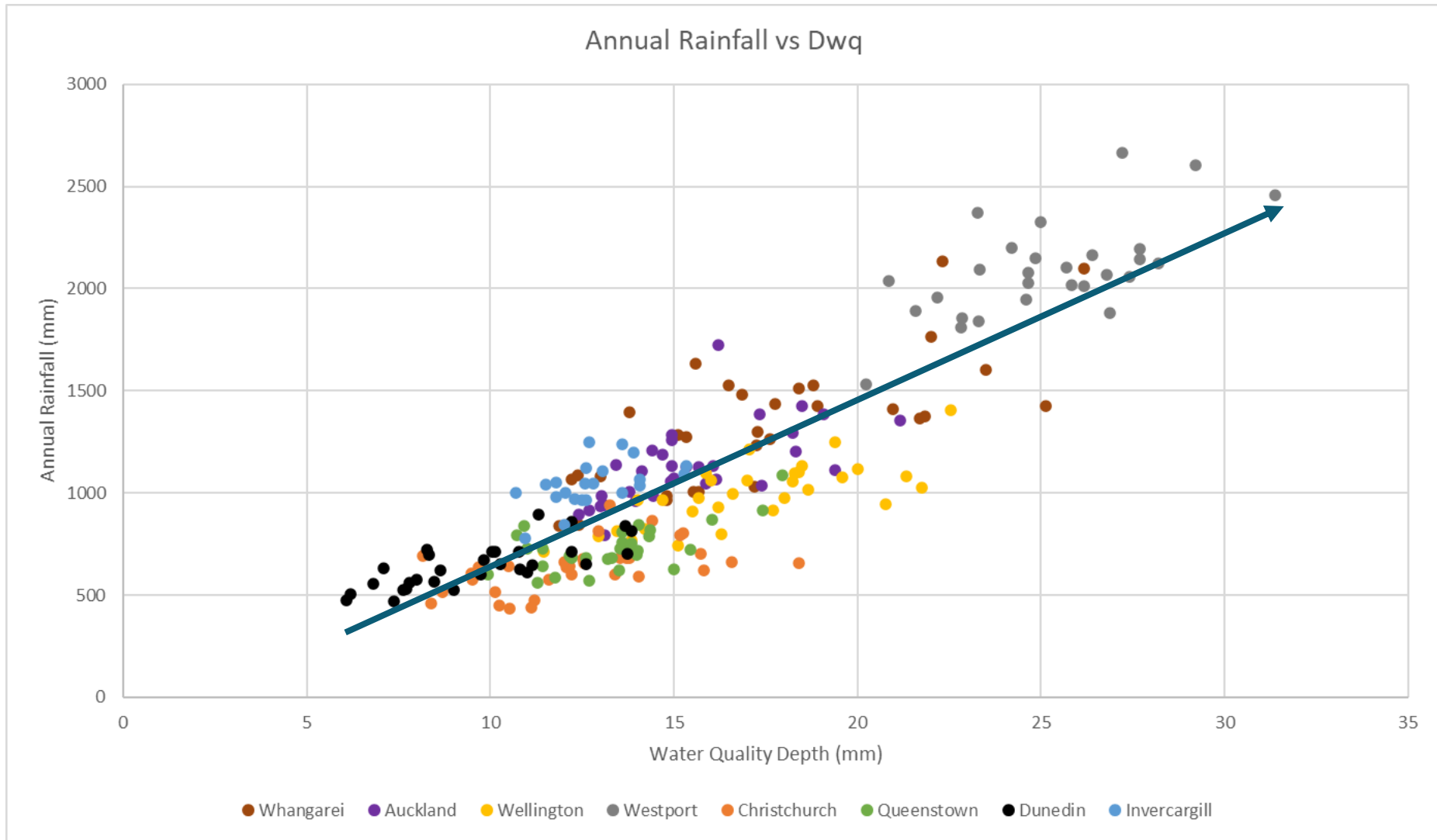
# ANNUAL RAINFALL vs WATER QUALITY RAINFALL DEPTH

- Statistically Significant Relationship?

	Auckland	Christchurch	Dunedin	Invercargill	Queenstown	Westport	Whangārei	Wellington
AR vs D <sub>WQ</sub>	YES	YES	YES	NO	YES	YES	YES	YES



P-value 0.0016



There is likely a correlation between annual rainfall and water quality rainfall depth

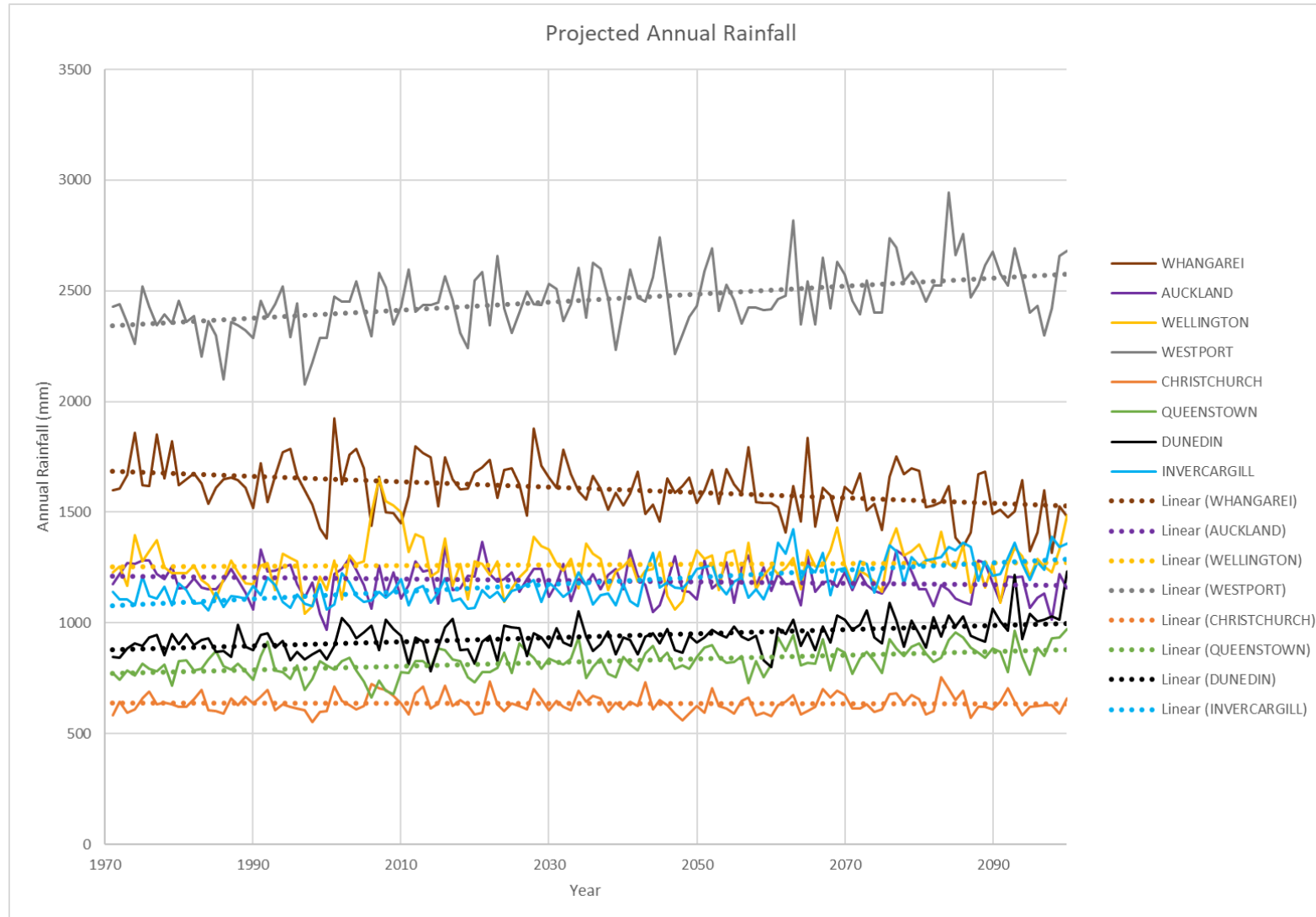
# ANNUAL RAINFALL vs WATER QUALITY RAINFALL INTENSITY

- Statistically Significant Relationship?

	Auckland	Christchurch	Dunedin	Invercargill	Queenstown	Westport	Whangārei	Wellington
AR vs $I_{WQ}$	YES	YES	NO	NO	NO	NO	NO	NO

Generally not well correlated

# ANNUAL RAINFALL PROJECTIONS



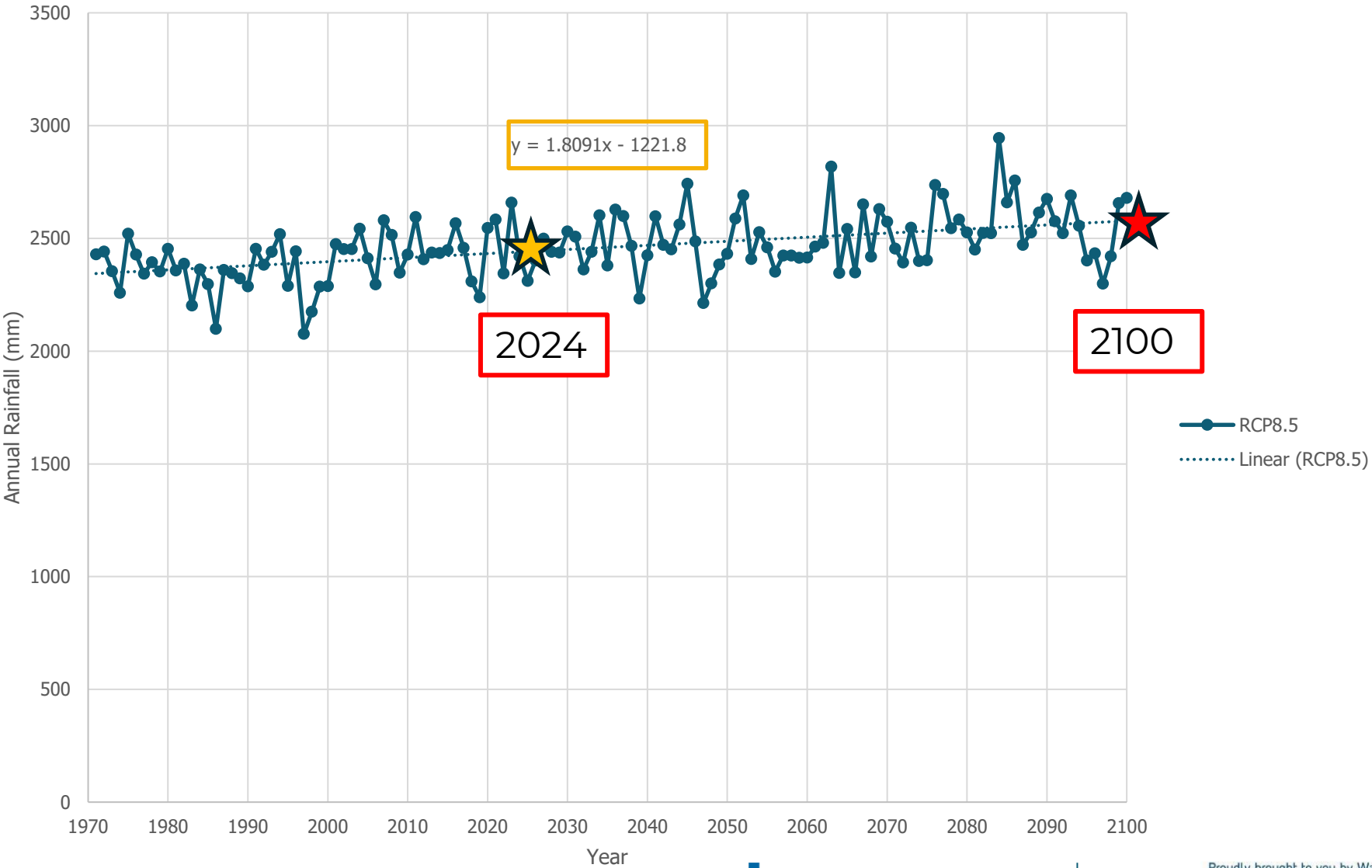
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**Stormwater 2024**

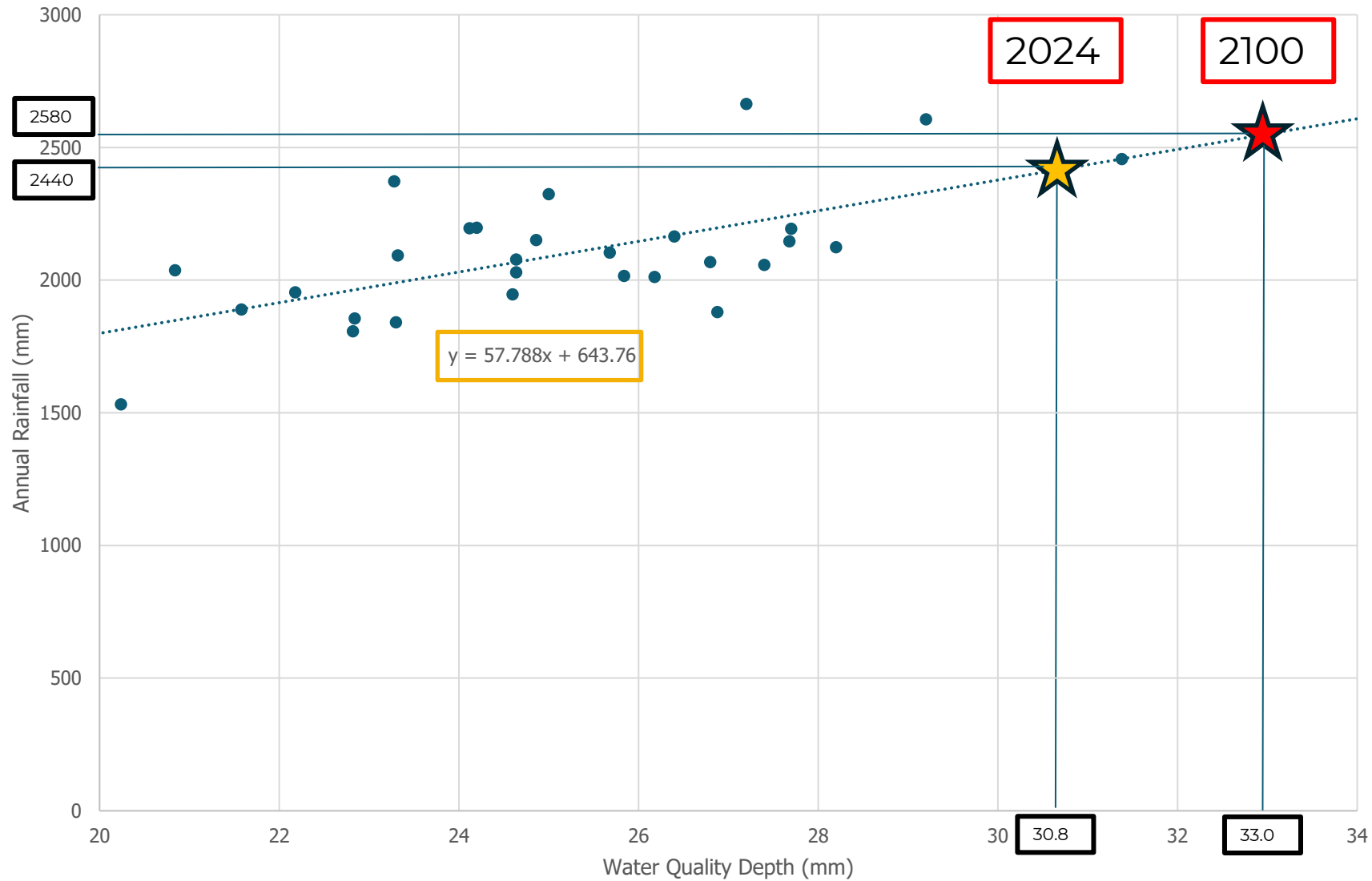
15-17 May | Takina Wellington Te Whanganui-a-Tara



# Westport Projected Annual Rainfall



# Westport Annual Rainfall vs WQD



Location	Projected change in annual rainfall (mm)			Estimated change in D <sub>wQ</sub> (mm)		
	2024	2100	% change	2024	2100	% change
<b>Auckland</b>	1193	1168	-2.1%	16.7	16.2	-2.7%
<b>Christchurch</b>	637	637	0.0%	12.4	12.4	-0.1%
<b>Dunedin</b>	927	997	7.5%	17.5	19.4	9.8%
<b>Queenstown</b>	816	880	7.9%	15.5	17.3	10.2%
<b>Westport</b>	2440	2577	5.6%	30.8	33.0	6.6%
<b>Invercargill*</b>	1164	1286	10.5%	-	-	-
<b>Whangarei</b>	1620	1528	-5.7%	22.1	20.6	-7.1%
<b>Wellington</b>	1261	1271	0.8%	23.4	23.6	1.0%

\* No estimation for D<sub>wQ</sub> provided as the relationship between annual D<sub>wQ</sub> and annual rainfall for Invercargill was not considered statistically significant based on the dataset analysed (p-value 0.13)

# SUMMARY

- No observed relationship between annual rainfall and mean average temperature
- Water quality rainfall intensity and annual rainfall are generally not well correlated
- Likely a relationship between the water quality depth and annual rainfall
- For the locations assessed, based on RCP 8.5 projections, there is an estimated change of water quality depth of -7% to +10% from 2024 to 2100

# KEY MESSAGES

- In locations where annual rainfall is predicted to increase, prudence, e.g., providing additional space for future enlargement, is advised for now
- A similar assessment should be repeated in line with the release of a new IPCC assessment report
- Ideally all stakeholders involved in stormwater management would be aware of the predicted changes to annual rainfall

# CONSEQUENCES?

- Treatment outcomes impacted
- More frequent maintenance
- Additional size? Additional space? Budget?

# WHO IS MOST IMPACTED?

- Regulators – maintaining treatment outcomes
- Asset Owners and Managers – long term performance and costs





**Thank you!**  
**Questions? Patai?**