



DERWENT VALLEY COUNCIL



Climate Change Information for Decision Making

T.A. Remenyi, N. Earl, P.T. Love, D.A. Rollins, R.M.B. Harris
*Climate Futures Programme, Discipline of Geography & Spatial Sciences,
University of Tasmania*

THE PURPOSE OF THIS DOCUMENT

This document summarises key climate indices useful to operational council staff. The climate indices were selected in direct consultation with council personnel and reflect the operational, tactical and strategic climate information needs for decision makers within all of the local councils of southern Tasmania.

This document expands upon previously produced *local profiles* and has been developed to support decision making across Derwent Valley's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Derwent Valley has been developed using outputs from the *Climate Futures for Tasmania Project* and the *Climate Futures Australasian Projections 2019 data archive*, developed by the University of Tasmania's Climate Futures Programme.

All values are based on the projections generated by the Climate Futures Programme, using previously published results. Descriptive documentation and supporting reports can be found here: <http://climatefutures.org.au>. This document is to be reviewed and updated when more up-to-date information becomes available, or at 5-yearly intervals. It should be considered in conjunction with Derwent Valley's policies and strategies, alongside technical and industry standards.

Values given are the multi-model mean from an ensemble of six downscaled global climate models based on the *business as usual* high emissions scenario RCP8.5 (the scenario human society is currently most closely following). Averaging across the ensemble smooths out the inter-annual variability, revealing the forced climate response.

For most variables, the range between climate models is not large relative to the percent change projected into the future.

In order to capture the regional variability, the data were separated into *cool* (< 25th percentile), *average* (between the 25th and 75th percentile) or *warm* (> 75th percentile) grid cells, based on average temperature during the base-line period, 1961–1990. These three groups of values were then analysed and presented separately. This provides councils with greater utility when managing a diverse landscape (NB: municipalities with small spatial extents have limited differences captured across the municipality at 10km² resolution). It is the responsibility of the user to determine which values may be most appropriate for a given application. For example, if building a road over Vines Saddle, it would be more useful to apply values from the cooler table, whereas for estimating future high-intensity rainfall within Kingston CBD, values from the warmer table would be more appropriate.

CURRENT CLIMATE AND RECENT TRENDS

All Tasmanian municipalities have a temperate, maritime climate with relatively mild winters at low elevations, transitioning towards warm alpine winters at higher elevations. Long-term average temperatures have risen in the decades since the 1950s at a rate of up to 0.1 °C per decade, with this rate expected to increase from 2020 onwards.

Despite covering small geographic areas all municipalities experience marked rainfall gradients, with average annual rainfall from about 600 mm per year at lower elevations and about 1500 mm per year at higher elevations. There has been a decline in average annual rainfall since the mid 1970s, and this decline has been strongest in autumn and enhanced over higher elevation regions.

EXTREME EVENTS

The changes in climate that are most likely to impact upon the each municipality's infrastructure, roads, the local community and the environment are an increase in intensity of extreme events. Potential impacts by 2100 are as follows (following the *business as usual* high emissions scenario RCP8.5):

- Increased evaporation and longer dry periods coupled with more extreme temperatures are likely to enhance the occurrence and intensity of bushfires.
 - The frequency of extremely hot days (> 40°C) is projected to increase. Heat wave frequency is projected to remain stable, but will increase in intensity (warmer days and nights).
 - The Annual Exceedance Probability (AEP) is a measure of the rarity of an event. Rainfall AEPs are expressed as the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. Heavier rainfall events are expected within a warmer climate. High daily runoff events are likely to increase, including those that may lead to erosion or flooding.
 - Inundation along all coastal frontage will increase due to sea level rise. This means the coastal inundation AEP values for all probability events will increase in intensity. The current 100-year coastal inundation event may become a 50-year event by 2030, and a 5-year event by 2090.
-

Table 1: **Derwent Valley local government area: Cool subregions**

Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	8.3	8.9	0.5	6.2	9.4	1.1	12.8	10.1	1.7	20.9	10.9	2.5	30.2	11.5	3.2	38.1
Average daily maximum temperature (°C)	12.8	13.4	0.6	4.6	14	1.2	9.5	14.8	2	15.4	15.7	2.8	22.2	16.4	3.6	27.7
Average daily minimum temperature (°C)	3.9	4.3	0.4	11.5	4.8	0.9	23.7	5.4	1.5	39	6.1	2.2	56.7	6.7	2.8	72.5
Hottest daily temperature of the year (°C)	32.1	32.9	0.8	2.3	33.8	1.7	5.4	34.8	2.6	8.2	35.6	3.4	10.7	36	3.9	12.2
Temperature of warmest days [99 th percentile] (°C)	28.1	28.9	0.8	2.9	29.8	1.6	5.9	30.8	2.7	9.7	32	3.9	13.9	32.4	4.3	15.3
Temperature of warmest nights [99 th percentile] (°C)	12.8	13.4	0.6	4.4	13.9	1	7.8	14.5	1.6	12.5	15.2	2.3	18.2	15.5	2.6	20.4
Temperature of coldest nights [1 st percentile] (°C)	-3.4	-3.1	0.3	7.9	-2.8	0.6	18	-2.3	1.1	31.8	-1.7	1.7	50.4	-1.1	2.3	68.5
Average annual frost risk days (<2°C)	114	98	-16	-14	84	-29	-25.8	67	-46	-40.8	51	-63	-55.5	38	-76	-66.6
Average annual freeze risk days (<0°C)	50	41	-10	-19.3	33	-17	-34.4	24	-26	-52.5	16	-34	-68	10	-40	-79.5
Average annual summer days (>25°C)	10	12	2	24.7	15	5	51.2	18	8	82	22	12	121.7	25	15	151.7
Average annual hot days (>30°C)	2	2	1	39.2	4	2	108.9	6	4	224.5	8	7	387.4	10	9	510.8
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	37600	44800	7200	19.1	54100	16500	43.9	67800	30200	80.3	89000	51400	136.7	112100	74500	198.1
Average annual evaporation (mm)	727	745	18	2.4	782	54	7.4	825	97	13.4	871	143	19.7	940	212	29.2
Average annual rainfall (mm)	1642	1563	-78	-4.8	1512	-130	-7.9	1492	-150	-9.1	1471	-170	-10.4	1545	-97	-5.9
Seasonal rainfall - Winter (mm)	608	595	-13	-2.2	582	-26	-4.3	594	-14	-2.3	592	-16	-2.7	624	16	2.7
Seasonal rainfall - Spring (mm)	413	396	-17	-4.1	361	-52	-12.5	354	-59	-14.2	361	-52	-12.5	345	-68	-16.4
Seasonal rainfall - Summer (mm)	266	244	-22	-8.4	250	-16	-6.1	233	-33	-12.4	216	-50	-18.9	236	-30	-11.2
Seasonal rainfall - Autumn (mm)	380	363	-17	-4.5	353	-27	-7.1	344	-36	-9.6	336	-45	-11.8	357	-23	-6
Annual maximum daily rainfall (mm)	106	103	-3	-2.9	113	6	6	115	9	8.4	113	7	6.5	141	35	33
Rainfall Extreme - 24hr 10% AEP (mm) ^a	141	145	4	2.6	149	8	5.5	154	13	9	159	18	12.9	164	23	16.3
Rainfall Extreme - 24hr 5% AEP (mm) ^a	165	169	4	2.6	174	9	5.5	179	15	9	186	21	12.9	191	27	16.3
Rainfall Extreme - 24hr 1% AEP (mm) ^a	217	223	6	2.6	229	12	5.5	237	19	9	245	28	12.9	253	36	16.3
Rainfall Extreme - 24hr 0.5% AEP (mm) ^a	243	250	6	2.6	257	13	5.5	265	22	9	275	31	12.9	283	40	16.3
Rainfall Extreme - 48hr 10% AEP (mm) ^a	192	197	5	2.6	203	11	5.5	209	17	9	217	25	12.9	224	31	16.3
Rainfall Extreme - 48hr 5% AEP (mm) ^a	221	227	6	2.6	233	12	5.5	241	20	9	250	29	12.9	258	36	16.3
Rainfall Extreme - 48hr 1% AEP (mm) ^a	295	303	8	2.6	311	16	5.5	321	26	9	333	38	12.9	343	48	16.3
Rainfall Extreme - 48hr 0.5% AEP (mm) ^a	332	340	9	2.6	350	18	5.5	361	30	9	374	43	12.9	386	54	16.3
Average annual cumulative Forest Fire Danger Index	415	447	32	7.6	482	67	16.1	527	112	27	582	167	40.3	631	216	51.9
Sea level - 1% AEP with Freeboard (m) ^b	1.66	1.74	0.08	4.8	1.82	0.16	9.6	1.9	0.24	14.5	2.18	0.52	31.3	2.6	0.94	56.6

^aBased on recommendations from *Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14th May 2019.*

^bBased on recommendations from *Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): *Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.*

Table 2: **Derwent Valley local government area: Average subregions**

Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	9.2	9.7	0.5	5.8	10.3	1.1	12	11	1.8	19.8	11.8	2.6	28.6	12.5	3.3	36.3
Average daily maximum temperature (°C)	13.7	14.3	0.6	4.4	14.9	1.2	9.1	15.7	2.1	15.1	16.6	3	21.7	17.4	3.8	27.4
Average daily minimum temperature (°C)	4.7	5.1	0.5	9.8	5.6	0.9	20.2	6.2	1.6	33.5	7	2.3	48.6	7.6	2.9	62.3
Hottest daily temperature of the year (°C)	33.3	34.1	0.8	2.4	35	1.7	5.1	35.9	2.6	7.9	36.8	3.5	10.5	37.4	4.1	12.3
Temperature of warmest days [99 th percentile] (°C)	28.9	29.8	0.9	3.1	30.6	1.7	5.9	31.8	2.9	9.9	33	4.1	14.1	33.4	4.5	15.6
Temperature of warmest nights [99 th percentile] (°C)	13.4	13.9	0.5	4	14.4	1	7.4	15	1.7	12.4	15.8	2.4	17.9	16.2	2.8	20.9
Temperature of coldest nights [1 st percentile] (°C)	-2.7	-2.4	0.3	11.6	-2	0.7	25.6	-1.5	1.2	44	-0.8	1.9	69.4	-0.2	2.5	92.2
Average annual frost risk days (<2°C)	85	71	-14	-16.3	59	-25	-29.8	45	-40	-46.8	32	-52	-62	23	-62	-73.3
Average annual freeze risk days (<0°C)	32	25	-7	-23.1	19	-13	-40	13	-19	-59.9	8	-24	-75.2	5	-27	-85.4
Average annual summer days (>25°C)	12	15	3	22.6	18	6	47	21	9	76.9	26	14	115	30	18	144.2
Average annual hot days (>30°C)	2	3	1	42.9	5	3	107.9	8	5	219.6	11	9	363.4	14	12	503.7
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	51000	61100	10100	19.8	74200	23200	45.5	93900	42900	84.1	124500	73500	144.1	158500	107500	210.8
Average annual evaporation (mm)	766	787	21	2.7	820	54	7	874	108	14.1	929	162	21.2	1014	248	32.4
Average annual rainfall (mm)	1975	1877	-99	-5	1811	-164	-8.3	1779	-196	-9.9	1752	-223	-11.3	1822	-154	-7.8
Seasonal rainfall - Winter (mm)	745	730	-15	-2	717	-28	-3.8	725	-20	-2.7	723	-22	-3	753	8	1.1
Seasonal rainfall - Spring (mm)	499	473	-26	-5.2	432	-67	-13.4	423	-76	-15.3	431	-68	-13.6	412	-87	-17.4
Seasonal rainfall - Summer (mm)	302	276	-27	-8.8	275	-27	-9.1	257	-46	-15.1	235	-67	-22.1	256	-46	-15.3
Seasonal rainfall - Autumn (mm)	460	439	-21	-4.5	428	-31	-6.8	414	-46	-10	403	-57	-12.4	422	-37	-8.1
Annual maximum daily rainfall (mm)	106	103	-3	-2.9	113	6	6	115	9	8.4	113	7	6.5	141	35	33
Rainfall Extreme - 24hr 10% AEP (mm) ^a	141	145	4	2.7	149	8	5.6	154	13	9.3	160	19	13.5	165	24	17.1
Rainfall Extreme - 24hr 5% AEP (mm) ^a	164	169	5	2.7	174	9	5.6	180	15	9.3	187	22	13.5	193	28	17.1
Rainfall Extreme - 24hr 1% AEP (mm) ^a	217	223	6	2.7	229	12	5.6	237	20	9.3	246	29	13.5	254	37	17.1
Rainfall Extreme - 24hr 0.5% AEP (mm) ^a	243	250	7	2.7	257	14	5.6	266	23	9.3	276	33	13.5	285	42	17.1
Rainfall Extreme - 48hr 10% AEP (mm) ^a	192	197	5	2.7	203	11	5.6	210	18	9.3	218	26	13.5	225	33	17.1
Rainfall Extreme - 48hr 5% AEP (mm) ^a	221	227	6	2.7	234	12	5.6	242	21	9.3	251	30	13.5	259	38	17.1
Rainfall Extreme - 48hr 1% AEP (mm) ^a	295	303	8	2.7	311	17	5.6	322	27	9.3	334	40	13.5	345	50	17.1
Rainfall Extreme - 48hr 0.5% AEP (mm) ^a	331	340	9	2.7	350	19	5.6	362	31	9.3	376	45	13.5	388	57	17.1
Average annual cumulative Forest Fire Danger Index	378	409	31	8.2	440	62	16.4	488	110	29	543	165	43.6	592	214	56.5
Sea level - 1% AEP with Freeboard (m) ^b	1.66	1.74	0.08	4.8	1.82	0.16	9.6	1.9	0.24	14.5	2.18	0.52	31.3	2.6	0.94	56.6

^aBased on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14th May 2019.

^bBased on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 3: **Derwent Valley local government area: Warm subregions**

Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	10.4	10.9	0.5	4.8	11.4	1	9.8	12.1	1.7	16.3	12.8	2.4	23.4	13.5	3.1	29.5
Average daily maximum temperature (°C)	15.2	15.8	0.5	3.5	16.4	1.1	7.4	17.1	1.9	12.2	17.9	2.7	17.5	18.6	3.3	21.8
Average daily minimum temperature (°C)	5.6	6	0.5	8.2	6.5	0.9	16.6	7.1	1.5	27.5	7.8	2.2	39.6	8.4	2.8	50.8
Hottest daily temperature of the year (°C)	35.4	36.2	0.8	2.3	36.8	1.4	3.9	37.8	2.4	6.8	38.3	2.9	8.1	38.8	3.3	9.4
Temperature of warmest days [99 th percentile] (°C)	30.2	30.8	0.7	2.3	31.5	1.4	4.6	32.6	2.4	8	33.6	3.4	11.4	33.9	3.7	12.3
Temperature of warmest nights [99 th percentile] (°C)	14.4	14.9	0.5	3.4	15.3	0.9	6.3	15.8	1.4	9.7	16.5	2	14.2	16.8	2.3	16.3
Temperature of coldest nights [1 st percentile] (°C)	-2.4	-2.1	0.3	14.1	-1.7	0.7	27.7	-1.3	1.1	47.3	-0.6	1.8	74.3	0	2.4	101.1
Average annual frost risk days (<2°C)	65	54	-12	-17.7	45	-20	-30.8	34	-31	-48.3	24	-41	-63	17	-49	-74.5
Average annual freeze risk days (<0°C)	24	19	-5	-22.2	15	-9	-38.5	10	-14	-58.1	6	-18	-73.6	4	-20	-83.8
Average annual summer days (>25°C)	16	18	3	15.9	21	5	33.7	25	9	56.6	29	13	83.1	32	16	103.6
Average annual hot days (>30°C)	4	5	1	29.3	7	3	67.5	9	5	130.6	12	8	200.1	15	11	265.8
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	71300	85200	13900	19.5	102500	31200	43.8	129000	57700	80.9	168600	97300	136.5	213400	142100	199.3
Average annual evaporation (mm)	880	895	16	1.8	931	52	5.9	980	101	11.4	1030	151	17.1	1108	228	25.9
Average annual rainfall (mm)	1506	1432	-74	-4.9	1392	-114	-7.6	1371	-135	-9	1352	-154	-10.2	1401	-105	-7
Seasonal rainfall - Winter (mm)	544	529	-15	-2.8	518	-25	-4.7	524	-19	-3.6	526	-18	-3.3	549	5	0.9
Seasonal rainfall - Spring (mm)	378	361	-17	-4.5	331	-46	-12.3	325	-53	-13.9	330	-48	-12.7	312	-65	-17.3
Seasonal rainfall - Summer (mm)	249	229	-21	-8.2	236	-13	-5.3	222	-28	-11.1	208	-42	-16.7	220	-29	-11.8
Seasonal rainfall - Autumn (mm)	359	346	-13	-3.7	338	-21	-5.9	330	-28	-7.9	319	-40	-11.1	338	-21	-5.8
Annual maximum daily rainfall (mm)	106	103	-3	-2.9	113	6	6	115	9	8.4	113	7	6.5	141	35	33
Rainfall Extreme - 24hr 10% AEP (mm) ^a	141	145	4	2.5	149	7	5.2	154	12	8.7	159	18	12.5	164	22	15.7
Rainfall Extreme - 24hr 5% AEP (mm) ^a	165	169	4	2.5	173	9	5.2	179	14	8.7	185	21	12.5	191	26	15.7
Rainfall Extreme - 24hr 1% AEP (mm) ^a	218	223	6	2.5	229	11	5.2	236	19	8.7	245	27	12.5	252	34	15.7
Rainfall Extreme - 24hr 0.5% AEP (mm) ^a	244	250	6	2.5	256	13	5.2	265	21	8.7	274	30	12.5	282	38	15.7
Rainfall Extreme - 48hr 10% AEP (mm) ^a	192	197	5	2.5	203	10	5.2	209	17	8.7	216	24	12.5	223	30	15.7
Rainfall Extreme - 48hr 5% AEP (mm) ^a	222	227	6	2.5	233	12	5.2	241	19	8.7	249	28	12.5	257	35	15.7
Rainfall Extreme - 48hr 1% AEP (mm) ^a	295	303	7	2.5	311	15	5.2	321	26	8.7	332	37	12.5	342	46	15.7
Rainfall Extreme - 48hr 0.5% AEP (mm) ^a	332	340	8	2.5	349	17	5.2	361	29	8.7	373	41	12.5	384	52	15.7
Average annual cumulative Forest Fire Danger Index	887	927	40	4.5	994	106	12	1069	182	20.5	1157	270	30.4	1231	343	38.7
Sea level - 1% AEP with Freeboard (m) ^b	1.66	1.74	0.08	4.8	1.82	0.16	9.6	1.9	0.24	14.5	2.18	0.52	31.3	2.6	0.94	56.6

^aBased on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14th May 2019.

^bBased on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Climate Change Information for Decision Making - Derwent Valley

©Copyright The University of Tasmania 2020.

This work is copyright. It may be reproduced in whole or in part for study or training purposes subject to the inclusion of an acknowledgement of the source, but not for commercial sale or use. Reproduction for purposes other than those listed above requires the written permission of the University of Tasmania.

Enquires

Requests and enquiries concerning reproduction rights should be addressed to:

Discipline of Geography & Spatial Sciences; School of Technology, Environment & Design; University of Tasmania

Private Bag 78

Hobart Tasmania 7001

Tel: +61 3 6226 1511

Email: ted-admin@utas.edu.au

Disclaimer

The University of Tasmania advises that the information contained in this report comprises general statements based on computer modelling for climate change scenarios and, as such, there are inherent uncertainties involved. While every effort has been made to ensure that data is accurate, the University of Tasmania provides no warranty or guarantee of any kind as to the accuracy of the data or its performance or fitness for a particular use or purpose. The use of this material is entirely at the risk of a user. To the maximum extent permitted by law, the University of Tasmania, its participating organisations and their officers, employees, contractors and agents, exclude liability for any loss, damage, costs or expenses whether direct, indirect, consequential including loss of profits, opportunity and third party claims that may be caused through the use of, reliance upon, or interpretation of the material in this report.