City of HOBART

Southern Tasmanian COUNCILS AUTHORITY

Climate Change Information for Decision Making

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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 Hobart's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Hobart 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 Hobart'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 currenty 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* ($< 25^{th}$ percentile), *average* (between the 25^{th} and 75^{th} percentile) or *warm* ($> 75^{th}$ percentile) grid cells, based on average temperature during the baseline period, 1961–1990. These three groups of values were then analysed and presented separately. This provides councils with greater utility when mangaing a diverse landscape (NB: municiaplities with small spatial extents have limited differences captured across the municipality at 10km^2 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 Vinces 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 indunation 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: **Hobart 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)	8.4	8.9	0.4	5.3	9.4	1	11.4	10	1.6	18.8	10.7	2.3	27.1	11.3	2.9	33.8
Average daily maximum temperature (°C)	12.7	13.2	0.5	3.6	13.7	1	8.1	14.4	1.7	13.3	15.2	2.4	19.2	15.7	3	23.6
Average daily minimum temperature (°C)	4.2	4.6	0.4	10.4	5.1	0.9	21.3	5.6	1.5	35.4	6.3	2.1	51	6.9	2.7	64.7
Hottest daily temperature of the year (°C)	30.4	31.2	0.8	2.5	31.9	1.5	4.9	32.7	2.3	7.6	33.3	2.9	9.6	33.7	3.3	10.9
Temperature of warmest days [99^{th} percentile] (°C)	27	27.5	0.6	2.2	28.1	1.2	4.4	29	2.1	7.7	30	3.1	11.4	30.2	3.2	11.9
Temperature of warmest nights [99^{th} percentile] (°C)	13.1	13.5	0.4	3.3	13.9	0.8	6.3	14.4	1.3	9.9	15.1	2	15.1	15.3	2.2	17.1
Temperature of coldest nights [1^{st} percentile] (°C)	-2.8	-2.4	0.3	12.5	-2.1	0.7	25.5	-1.5	1.2	44.2	-0.9	1.8	67	-0.3	2.4	88.4
Average annual frost risk days (<2°C)	104	90	-14	-13.7	77	-28	-26.4	60	-45	-42.8	44	-60	-57.9	31	-73	-70.2
Average annual freeze risk days (<0°C)	43	33	-10	-22.4	27	-16	-37.8	18	-25	-58.6	11	-32	-74.4	6	-36	-85
Average annual summer days (>25°C)	7	8	1	17.4	10	2	33.5	11	4	56.6	13	6	83.7	14	7	98.9
Average annual hot days (>30°C)	1	2	0	27.2	2	1	69.1	3	2	134.3	4	3	222.1	5	4	269.9
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	41900	49700	7800	18.6	59400	17500	41.8	74300	32400	77.3	95900	54000	128.9	119200	77300	184.5
Average annual evaporation (mm)	765	772	7	0.9	809	44	5.7	851	86	11.3	896	131	17.1	962	197	25.8
Average annual rainfall (mm)	1113	1080	-34	-3	1071	-42	-3.8	1073	-40	-3.6	1048	-66	-5.9	1109	-4	-0.4
Seasonal rainfall - Winter (mm)	317	299	-18	-5.7	287	-30	-9.5	307	-10	-3.3	303	-14	-4.5	328	11	3.3
Seasonal rainfall - Spring (mm)	277	269	-8	-2.8	260	-16	-5.9	252	-25	-9	251	-25	-9.2	227	-50	-18.1
Seasonal rainfall - Summer (mm)	260	252	-8	-3	284	24	9.3	265	5	1.7	260	0	0.1	279	19	7.2
Seasonal rainfall - Autumn (mm)	277	284	7	2.6	264	-13	-4.7	275	-2	-0.7	257	-20	-7.1	291	14	5.1
Annual maximum daily rainfall (mm)	77	77	0	0.4	88	11	14.3	81	5	6	79	2	2.9	92	16	20.5
Rainfall Extreme - 24hr 10% AEP (mm)[a]	172	176	4	2.3	180	8	4.9	186	14	8.1	192	20	11.7	197	25	14.6
Rainfall Extreme - 24hr 5% AEP (mm)[a]	196	201	5	2.3	206	10	4.9	212	16	8.1	219	23	11.7	225	29	14.6
Rainfall Extreme - 24hr 1% AEP (mm)[a]	253	259	6	2.3	266	12	4.9	274	21	8.1	283	30	11.7	290	37	14.6
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	280	287	6	2.3	294	14	4.9	303	23	8.1	313	33	11.7	321	41	14.6
Rainfall Extreme - 48hr 10% AEP (mm)[a]	223	228	5	2.3	233	11	4.9	241	18	8.1	249	26	11.7	255	32	14.6
Rainfall Extreme - 48hr 5% AEP (mm)[a]	253	259	6	2.3	265	12	4.9	273	20	8.1	283	30	11.7	290	37	14.6
Rainfall Extreme - 48hr 1% AEP (mm)[a]	327	335	7	2.3	343	16	4.9	354	26	8.1	365	38	11.7	375	48	14.6
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	361	370	8	2.3	379	18	4.9	391	29	8.1	404	42	11.7	414	53	14.6
Average annual cummulative Forest Fire Danger Index	625	641	16	2.6	683	58	9.3	715	90	14.4	775	150	24	818	193	30.9
Sea level - 1% AEP with Freeboard (m)[b]	1.67	1.75	0.08	4.8	1.82	0.15	9	1.9	0.23	13.8	2.18	0.51	30.5	2.6	0.93	55.7

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

[b] *Based 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: **Hobart 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)	11.7	12.3	0.5	4.7	12.9	1.1	9.5	13.6	1.9	16.3	14.5	2.8	23.5	15.2	3.5	29.6
Average daily maximum temperature (°C)	16.3	16.9	0.6	3.4	17.5	1.2	7.2	18.3	2	12.3	19.2	2.9	17.8	19.9	3.6	22.3
Average daily minimum temperature (°C)	7.2	7.7	0.5	7.6	8.2	1.1	14.9	9	1.8	25.4	9.8	2.6	36.4	10.5	3.3	46.3
Hottest daily temperature of the year (°C)	35.2	35.9	0.7	2.1	36.9	1.8	5	37.6	2.5	7	38.7	3.5	9.9	39.1	3.9	11.1
Temperature of warmest days [99^{th} percentile] (°C)	30.2	31	0.8	2.7	31.7	1.5	4.8	33	2.7	9.1	34.2	4	13.3	34.7	4.5	14.9
Temperature of warmest nights [99^{th} percentile] (°C)	15.7	16.3	0.6	3.7	16.8	1.1	6.7	17.5	1.8	11.4	18.4	2.7	17.2	19.1	3.4	21.4
Temperature of coldest nights [1^{st} percentile] (°C)	-0.2	0.2	0.4	190.6	0.6	0.8	376.8	1.2	1.4	653.9	1.9	2.2	985.2	2.7	2.9	1330.7
Average annual frost risk days (<2°C)	29	21	-8	-28.7	16	-13	-45.9	9	-20	-68.4	5	-24	-83.9	2	-27	-92
Average annual freeze risk days (<0°C)	5	3	-2	-37.1	2	-3	-61.6	1	-4	-79	0	-5	-92.8	0	-5	-97.1
Average annual summer days (>25°C)	14	16	2	14.3	18	4	30.8	21	7	53.3	26	12	88.1	31	17	123.5
Average annual hot days (>30°C)	4	5	1	26.5	7	2	54.3	9	5	117.2	12	8	176.7	14	10	233.9
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	131900	163100	31200	23.7	201200	69300	52.5	268300	136400	103.4	366100	234200	177.6	480200	348300	264.1
Average annual evaporation (mm)	981	1020	39	4	1058	78	7.9	1176	195	19.9	1273	292	29.7	1414	434	44.2
Average annual rainfall (mm)	640	626	-14	-2.2	617	-23	-3.6	614	-26	-4.1	593	-47	-7.4	625	-15	-2.4
Seasonal rainfall - Winter (mm)	172	160	-12	-6.7	152	-19	-11.2	162	-10	-5.8	160	-12	-7	173	1	0.6
Seasonal rainfall - Spring (mm)	160	158	-3	-1.6	153	-8	-4.7	145	-15	-9.6	144	-16	-10.3	127	-33	-20.6
Seasonal rainfall - Summer (mm)	157	154	-3	-1.7	172	15	9.5	160	3	2.2	154	-3	-1.7	167	10	6.2
Seasonal rainfall - Autumn (mm)	162	169	7	4.3	155	-7	-4.2	162	0	-0.1	150	-13	-7.7	167	5	3.3
Annual maximum daily rainfall (mm)	77	77	0	0.4	88	11	14.3	81	5	6	79	2	2.9	92	16	20.5
Rainfall Extreme - 24hr 10% AEP (mm)[a]	171	176	5	2.8	181	10	5.7	188	17	9.8	195	24	14.2	202	31	17.9
Rainfall Extreme - 24hr 5% AEP (mm)[a]	195	201	6	2.8	207	11	5.7	215	19	9.8	223	28	14.2	230	35	17.9
Rainfall Extreme - 24hr 1% AEP (mm)[a]	252	259	7	2.8	267	14	5.7	277	25	9.8	288	36	14.2	297	45	17.9
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	279	287	8	2.8	295	16	5.7	306	27	9.8	318	40	14.2	329	50	17.9
Rainfall Extreme - 48hr 10% AEP (mm)[a]	221	228	6	2.8	234	13	5.7	243	22	9.8	253	31	14.2	261	40	17.9
Rainfall Extreme - 48hr 5% AEP (mm)[a]	252	259	7	2.8	266	14	5.7	276	25	9.8	287	36	14.2	297	45	17.9
Rainfall Extreme - 48hr 1% AEP (mm)[a]	325	335	9	2.8	344	19	5.7	357	32	9.8	372	46	14.2	384	58	17.9
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	360	370	10	2.8	380	21	5.7	395	35	9.8	411	51	14.2	424	64	17.9
Average annual cummulative Forest Fire Danger Index	1549	1568	20	1.3	1691	142	9.2	1793	244	15.8	1953	404	26.1	2065	516	33.3
Sea level - 1% AEP with Freeboard (m)[b]	1.67	1.75	0.08	4.8	1.82	0.15	9	1.9	0.23	13.8	2.18	0.51	30.5	2.6	0.93	55.7

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

[b] *Based 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: **Hobart 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)	11.9	12.4	0.5	3.8	12.9	1	8	13.5	1.6	13.4	14.2	2.3	19.3	14.8	2.9	24.1
Average daily maximum temperature (°C)	16.8	17.3	0.4	2.6	17.8	1	5.8	18.5	1.6	9.7	19.2	2.4	14	19.7	2.9	17.2
Average daily minimum temperature (°C)	7	7.5	0.5	6.6	7.9	0.9	13.4	8.6	1.6	22.4	9.3	2.2	32	9.9	2.8	40.7
Hottest daily temperature of the year (°C)	35	35.8	0.8	2.4	36.3	1.4	4	37.5	2.5	7.2	38.1	3.1	8.9	38.7	3.7	10.6
Temperature of warmest days [99^{th} percentile] (°C)	30.9	31.5	0.6	1.9	32.1	1.2	3.8	33.2	2.3	7.3	34.3	3.4	10.9	34.5	3.5	11.5
Temperature of warmest nights [99^{th} percentile] (°C)	15.7	16.2	0.4	2.7	16.5	0.8	5	16.9	1.2	7.4	17.5	1.8	11.4	17.8	2	12.8
Temperature of coldest nights [1^{st} percentile] (°C)	-0.7	-0.3	0.3	49.9	0	0.7	101.3	0.5	1.2	171.8	1.2	1.9	275.1	1.9	2.6	387.1
Average annual frost risk days (<2°C)	36	28	-9	-23.4	22	-14	-39.6	14	-22	-60.6	9	-28	-76.5	5	-31	-86.4
Average annual freeze risk days (<0°C)	8	6	-3	-29.9	4	-4	-48.9	3	-6	-68.2	1	-7	-84	1	-8	-92.3
Average annual summer days (>25°C)	18	20	1	8.2	22	4	20.6	25	7	38.4	29	11	62.1	32	14	77.2
Average annual hot days (>30°C)	6	7	1	22	8	2	40.8	10	5	81.3	12	6	112.8	14	8	142.2
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	123400	147800	24400	19.8	178000	54600	44.2	226300	102900	83.4	294900	171500	139	372200	248800	201.6
Average annual evaporation (mm)	1014	1018	4	0.4	1057	42	4.2	1106	91	9	1155	140	13.8	1233	219	21.6
Average annual rainfall (mm)	561	552	-9	-1.7	549	-12	-2.1	544	-17	-3.1	533	-28	-5	563	2	0.3
Seasonal rainfall - Winter (mm)	150	141	-8	-5.4	134	-15	-10.1	141	-8	-5.5	141	-8	-5.5	152	3	1.8
Seasonal rainfall - Spring (mm)	141	139	-1	-0.9	136	-5	-3.3	130	-11	-7.8	129	-11	-8.2	113	-27	-19.3
Seasonal rainfall - Summer (mm)	139	138	-1	-0.8	156	17	12.1	144	5	3.3	142	3	2.1	154	15	10.6
Seasonal rainfall - Autumn (mm)	141	146	5	3.5	136	-5	-3.8	142	1	0.9	133	-8	-5.6	151	10	7.1
Annual maximum daily rainfall (mm)	77	77	0	0.4	88	11	14.3	81	5	6	79	2	2.9	92	16	20.5
Rainfall Extreme - 24hr 10% AEP (mm)[a]	172	176	4	2.3	180	8	4.9	186	14	8.2	192	20	11.8	197	25	14.7
Rainfall Extreme - 24hr 5% AEP (mm)[a]	196	201	5	2.3	206	10	4.9	213	16	8.2	220	23	11.8	225	29	14.7
Rainfall Extreme - 24hr 1% AEP (mm)[a]	253	259	6	2.3	266	12	4.9	274	21	8.2	283	30	11.8	291	37	14.7
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	280	287	6	2.3	294	14	4.9	303	23	8.2	313	33	11.8	322	41	14.7
Rainfall Extreme - 48hr 10% AEP (mm)[a]	222	228	5	2.3	233	11	4.9	241	18	8.2	249	26	11.8	255	33	14.7
Rainfall Extreme - 48hr 5% AEP (mm)[a]	253	259	6	2.3	265	12	4.9	274	21	8.2	283	30	11.8	290	37	14.7
Rainfall Extreme - 48hr 1% AEP (mm)[a]	327	335	8	2.3	343	16	4.9	354	27	8.2	366	39	11.8	375	48	14.7
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	361	370	8	2.3	379	18	4.9	391	30	8.2	404	43	11.8	415	53	14.7
Average annual cummulative Forest Fire Danger Index	1717	1734	18	1	1863	146	8.5	1994	277	16.1	2169	452	26.3	2300	583	33.9
Sea level - 1% AEP with Freeboard (m)[b]	1.67	1.75	0.08	4.8	1.82	0.15	9	1.9	0.23	13.8	2.18	0.51	30.5	2.6	0.93	55.7

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

[b] *Based 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.

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