

## **Supplementary Material**

### **Rivers up in smoke: impacts of Australia's 2019–2020 megafires on riparian systems**

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**Table S1.** Methods used in this study.

Step 1	<p>Source the Open Access Fire Extent and Severity Mapping (FESM) 2019/2020 dataset published by NSW Department of Planning Infrastructure and Environment (DPIE). FESM 2019/2020 uses a random forest model to classify burn severity (a metric of the loss of biomass caused by fire) based on Sentinel 2 satellite images (DPIE 2020a).</p> <p>Burn severity is classified as:</p> <ol style="list-style-type: none"><li>1. Extreme, canopy was completely consumed;</li><li>2. High, canopy was completely scorched and partially consumed;</li><li>3. Moderate, canopy was partially scorched; and</li><li>4. Low, understory was burnt and canopy was unburnt (DPIE 2020a).</li></ol> <p>The accuracy of FESM is &gt;90% for unburned and extreme severity classes, and &gt;70% for low, moderate, and high severity classes (DPIE 2020a).</p>
Step 2	<p>In ArcGIS 10.8, extract river channel polylines from the Open Access NSW River Styles database (DPIE 2021a, Fryirs et al. 2021a) and intersect with polygons of each burn severity class from the FESM raster. A maximum of <math>\pm 10</math> m from channel centreline was used in this study.</p>
Step 3	<p>Calculate stream length within each burn severity class for each catchment and for four valley setting and river type classes; confined, partly confined, laterally unconfined with continuous channels, and laterally unconfined with discontinuous channels (Fryirs and Brierley 2018). Use the 'tabulate area' tool with the FESM raster and catchment boundary polygons, the latter sourced from DPIE (DPIE 2018).</p>
Step 4	<p>Apply a <math>1 \times 1235</math> grid to analyse the distribution of burned area across the region. In this study, a grid size of 1 km in latitude direction and 605 km in longitude direction covers the study area. Generate the burned area for each latitude distance (1 km) by tabulating this grid with the FESM raster.</p>
Step 5	<p>Spot check and verify the results produced from the FESM using available aerial and satellite images before and after the bushfires. In this study we used the images as follows: 1) Confined – Green Wattle Creek (Hawkesbury catchment) – September 2019 vs January 2020; 2) Partly-confined – Tuross River (Tuross catchment) – September 2019 vs March 2020; 3) Laterally unconfined with continuous channel - Tomaga River (Clyde catchment) – July 2019 vs January 2020; 4) Laterally unconfined with discontinuous channel - Marrangaroo Creek (Hawkesbury catchment) - September 2019 vs March 2020.</p>

**Table S2.** Total catchment area and total catchment area burnt in each coastal NSW catchment.

<b>Catchment</b>	<b>Total catchment area (km<sup>2</sup>)</b>	<b>Total catchment area burnt (km<sup>2</sup>)</b>	<b>% of total catchment area burnt</b>
<b>NORTH COAST</b>			
Tweed	1392.1	20.8	1.50%
Brunswick	660.1	0.0	0.00%
Richmond	9150.2	1508.7	16.49%
Clarence	29377.2	10279.2	34.99%
Bellinger/ Nambucca	4646.1	797.7	17.17%
Macleay	15449.6	4891.8	31.66%
Hastings	6196.6	2362.6	38.13%
<b>CENTRAL COAST</b>			
Manning	11290.6	2458.7	21.78%
Karuah	6281.4	429.2	6.83%
Hunter	29989.9	3564.2	11.88%
Macquarie Lakes	2245.9	33.1	1.47%
Hawkesbury- Nepean	31857.5	13415.3	42.11%
Sydney Basin/Georges	2643.8	0.0	0.00%
<b>SOUTH COAST</b>			
Illawarra Streams	1167.6	0.0	0.00%
Shoalhaven	10750.9	4387.9	40.81%
Clyde	5154.1	3559.8	69.07%
Moruya	2254.9	1580.7	70.10%
Tuross	3312.0	2453.0	74.06%
Bega	4387.6	1250.9	28.51%
Towamba	3390.4	2080.0	61.35%
<b>NORTH COAST</b>	<b>66871.9</b>	<b>19860.8</b>	<b>29.70%</b>
<b>CENTRAL COAST</b>	<b>85476.6</b>	<b>19900.6</b>	<b>23.28%</b>
<b>SOUTH COAST</b>	<b>29249.9</b>	<b>15312.4</b>	<b>52.35%</b>
<b>Total</b>	<b>181598.5</b>	<b>55073.8</b>	<b>30.33%</b>

**Table S3.** Total catchment area and area burnt in each severity class for all coastal NSW catchments.

	Burnt catchment area (km <sup>2</sup> )				% of total catchment area burnt			
	Low	Moderate	High	Extreme	Low	Moderate	High	Extreme
<b>NORTH COAST</b>								
<b>Tweed</b>	8.9	9.7	1.9	0.3	0.64%	0.70%	0.14%	0.02%
<b>Brunswick</b>	0.0	0.0	0.0	0.0	0.00%	0.00%	0.00%	0.00%
<b>Richmond</b>	501.8	553.9	363.0	90.0	5.48%	6.05%	3.97%	0.98%
<b>Clarence</b>	2351.1	3684.9	2759.2	1484.0	8.00%	12.54%	9.39%	5.05%
<b>Bellinger/ Nambucca</b>	151.0	342.0	176.9	127.9	3.25%	7.36%	3.81%	2.75%
<b>Macleay</b>	1764.0	1744.8	767.1	615.9	11.42%	11.29%	4.97%	3.99%
<b>Hastings</b>	503.9	885.3	517.5	456.0	8.13%	14.29%	8.35%	7.36%
<b>CENTRAL COAST</b>								
<b>Manning</b>	918.6	1150.5	222.2	167.4	8.14%	10.19%	1.97%	1.48%
<b>Karuah</b>	45.2	112.9	146.2	125.0	0.72%	1.80%	2.33%	1.99%
<b>Hunter</b>	995.2	1220.4	859.0	489.5	3.32%	4.07%	2.86%	1.63%
<b>Macquarie Lakes</b>	7.8	12.0	11.8	1.5	0.35%	0.54%	0.53%	0.07%
<b>Hawkesbury- Nepean</b>	3890.1	4915.4	2834.1	1775.8	12.21%	15.43%	8.90%	5.57%
<b>Sydney Basin/Georges</b>	0.0	0.0	0.0	0.0	0.00%	0.00%	0.00%	0.00%
<b>SOUTH COAST</b>								
<b>Illawarra Streams</b>	0.0	0.0	0.0	0.0	0.00%	0.00%	0.00%	0.00%
<b>Shoalhaven</b>	660.9	763.2	985.4	1978.4	6.15%	7.10%	9.17%	18.40%
<b>Clyde</b>	669.9	1287.1	802.7	800.1	13.00%	24.97%	15.57%	15.52%
<b>Moruya</b>	371.7	317.3	442.7	448.9	16.49%	14.07%	19.63%	19.91%
<b>Tuross</b>	454.4	287.3	742.1	969.2	13.72%	8.67%	22.41%	29.26%
<b>Bega</b>	391.4	181.1	356.3	322.0	8.92%	4.13%	8.12%	7.34%
<b>Towamba</b>	386.6	433.5	768.0	492.0	11.40%	12.79%	22.65%	14.51%
<b>NORTH COAST</b>	5280.7	7220.5	4585.6	2774.0	7.90%	10.80%	6.86%	4.15%
<b>CENTRAL COAST</b>	5856.9	7411.2	4073.3	2559.2	6.85%	8.67%	4.77%	2.99%
<b>SOUTH COAST</b>	2935.0	3269.5	4097.2	5010.6	10.03%	11.18%	14.01%	17.13%
<b>Total</b>	14072.5	17901.3	12756.1	10343.8	7.75%	9.86%	7.02%	5.70%

**Table S4.** Total stream length and total stream length burnt in each catchment

<b>Catchment</b>	<b>Total stream length (km)</b>	<b>Total stream length burnt (km)</b>	<b>Burnt stream length per catchment area (km/km<sup>2</sup>)</b>	<b>% of stream length burnt</b>
<b>NORTH COAST</b>				
<b>Tweed</b>	799.4	10.9	0.0078	1.36%
<b>Brunswick</b>	410.2	0.0	0.0000	0.00%
<b>Richmond</b>	4065.9	478.1	0.0523	11.76%
<b>Clarence</b>	14483.1	4751.5	0.1617	32.81%
<b>Bellinger/ Nambucca</b>	2336.2	360.2	0.0775	15.42%
<b>Macleay</b>	6852.4	2357.6	0.1526	34.40%
<b>Hastings</b>	2671.0	912.0	0.1472	34.15%
<b>CENTRAL COAST</b>				
<b>Manning</b>	4281.3	765.6	0.0678	17.88%
<b>Karuah</b>	2510.5	193.1	0.0307	7.69%
<b>Hunter</b>	11021.7	1054.5	0.0352	9.57%
<b>Macquarie Lakes</b>	682.2	25.3	0.0113	3.71%
<b>Hawkesbury- Nepean</b>	14616.9	5824.7	0.1828	39.85%
<b>Sydney Basin/Georges</b>	2971.2	0.0	0.0000	0.00%
<b>SOUTH COAST</b>				
<b>Illawarra Streams</b>	1143.1	0.0	0.0000	0.00%
<b>Shoalhaven</b>	4979.6	2224.3	0.2069	44.67%
<b>Clyde</b>	2191.8	1629.4	0.3161	74.34%
<b>Moruya</b>	1029.0	692.0	0.3069	67.24%
<b>Tuross</b>	1315.0	922.2	0.2785	70.13%
<b>Bega</b>	1730.5	438.5	0.0999	25.34%
<b>Towamba</b>	1213.2	626.2	0.1847	51.62%
<b>NORTH COAST</b>	31618.3	8870.3	0.1326	28.05%
<b>CENTRAL COAST</b>	37227.0	7863.2	0.0920	21.12%
<b>SOUTH COAST</b>	12459.1	6532.7	0.2233	52.43%
<b>Total</b>	81304.4	23266.2	0.1281	28.62%

**Table S5.** Total stream length burnt and percentage of stream length burnt in each severity class for all coastal NSW catchments.

	Total stream length burnt (km)				% of total stream length burnt			
	Low	Moderate	High	Extreme	Low	Moderate	High	Extreme
<b>NORTH COAST</b>								
<b>Tweed</b>	6.0	4.7	0.0	0.1	0.76%	0.59%	0.00%	0.01%
<b>Brunswick</b>	0.0	0.0	0.0	0.0	0.00%	0.00%	0.00%	0.00%
<b>Richmond</b>	184.9	201.5	67.0	24.7	4.55%	4.96%	1.65%	0.61%
<b>Clarence</b>	1341.1	1981.3	1033.2	395.9	9.26%	13.68%	7.13%	2.73%
<b>Bellinger/ Nambucca</b>	98.9	222.7	27.1	11.5	4.23%	9.53%	1.16%	0.49%
<b>Macleay</b>	950.1	1033.6	208.7	165.1	13.87%	15.08%	3.05%	2.41%
<b>Hastings</b>	251.8	517.3	110.2	32.7	9.43%	19.37%	4.13%	1.22%
<b>CENTRAL COAST</b>								
<b>Manning</b>	352.9	361.5	36.8	14.4	8.24%	8.44%	0.86%	0.34%
<b>Karuah</b>	21.6	76.2	66.2	29.1	0.86%	3.04%	2.64%	1.16%
<b>Hunter</b>	416.9	482.6	113.9	41.0	3.78%	4.38%	1.03%	0.37%
<b>Macquarie Lakes</b>	5.7	12.5	6.8	0.3	0.84%	1.84%	0.99%	0.04%
<b>Hawkesbury- Nepean</b>	1950.2	2886.9	693.3	294.3	13.34%	19.75%	4.74%	2.01%
<b>Sydney Basin/Georges</b>	0.0	0.0	0.0	0.0	0.00%	0.00%	0.00%	0.00%
<b>SOUTH COAST</b>								
<b>Illawarra Streams</b>	0.0	0.0	0.0	0.0	0.00%	0.00%	0.00%	0.00%
<b>Shoalhaven</b>	400.4	777.4	466.8	579.7	8.04%	15.61%	9.37%	11.64%
<b>Clyde</b>	317.4	910.9	238.9	162.2	14.48%	41.56%	10.90%	7.40%
<b>Moruya</b>	191.5	192.9	198.7	108.9	18.61%	18.74%	19.31%	10.58%
<b>Tuross</b>	236.6	186.1	272.1	227.4	18.00%	14.15%	20.69%	17.29%
<b>Bega</b>	163.3	79.0	130.5	65.8	9.43%	4.56%	7.54%	3.80%
<b>Towamba</b>	132.9	188.6	197.1	107.6	10.95%	15.55%	16.25%	8.87%
<b>NORTH COAST</b>	2832.9	3961.2	1446.2	630.0	8.96%	12.53%	4.57%	1.99%
<b>CENTRAL COAST</b>	2747.4	3819.8	917.0	379.1	7.38%	10.26%	2.46%	1.02%
<b>SOUTH COAST</b>	1442.0	2335.0	1504.2	1251.5	11.57%	18.74%	12.07%	10.04%
<b>Total</b>	7022.3	10115.9	3867.4	2260.6	8.64%	12.44%	4.76%	2.78%

**Table S6.** Total stream length and total stream length burnt for each valley setting.

	<b>Total stream length (km)</b>	<b>Total stream length burnt (km)</b>	<b>% of total stream length burnt</b>
<b>Confined</b>	38015.3	14622.2	38.46%
<b>Partly confined</b>	21451.6	3585.1	16.71%
<b>Laterally unconfined with continuous channels</b>	9886.4	696.6	7.05%
<b>Laterally unconfined with discontinuous channels</b>	5821.6	1075.1	18.47%
<b>Non-categorised</b>	6129.5	3287.2	53.63%

**Table S7.** Total stream length burnt and percentage of stream length burnt in each severity class for each valley setting.

	Total stream length burnt (km)				% of total stream length burnt			
	Low	Moderate	High	Extreme	Low	Moderate	High	Extreme
<b>Confined</b>	4335.1	6229.9	2641.4	1415.8	11.40%	16.39%	6.95%	3.72%
<b>Partly confined</b>	1116.3	1645.1	476.7	347.0	5.20%	7.67%	2.22%	1.62%
<b>Laterally unconfined with continuous channels</b>	244.6	299.5	90.3	62.2	2.47%	3.03%	0.91%	0.63%
<b>Laterally unconfined with discontinuous channels</b>	248.6	345.7	229.0	251.9	4.27%	5.94%	3.93%	4.33%
<b>Non-categorised</b>	1077.6	1595.7	430.0	183.8	17.58%	26.03%	7.02%	3.00%