

Landscape scale remediation reduces concentrations of suspended sediment and associated nutrients in alluvial gullies of a Great Barrier Reef catchment: evidence from a novel intensive monitoring approach

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Supporting Information

SI-1



Figure SI-1A. A lobe of the remediated gully, prior to remediation.



Figure SI-1B. Reshaping the remediated gully.

SI-1



Figure S1-C. Finished reshaping of remediated gully.



Figure S1-D. Spreading gypsum over remediated gully.

SI-1



Figure S1-E. Geotextile fabric laid over former gully head scarp



Figure S1-F. Rock capping remediated gully.

SI-1



Figure SI-1G. Remediated gully completed with check dams 2016.



Figure SI-1H. Remediated gully 2017

SI-1



Figure SI-II. Control Gully 2018.

SI-2



Figure SI-2 PASS sampler located in catchment drainage channel, upstream of the remediated gully.

SI-3

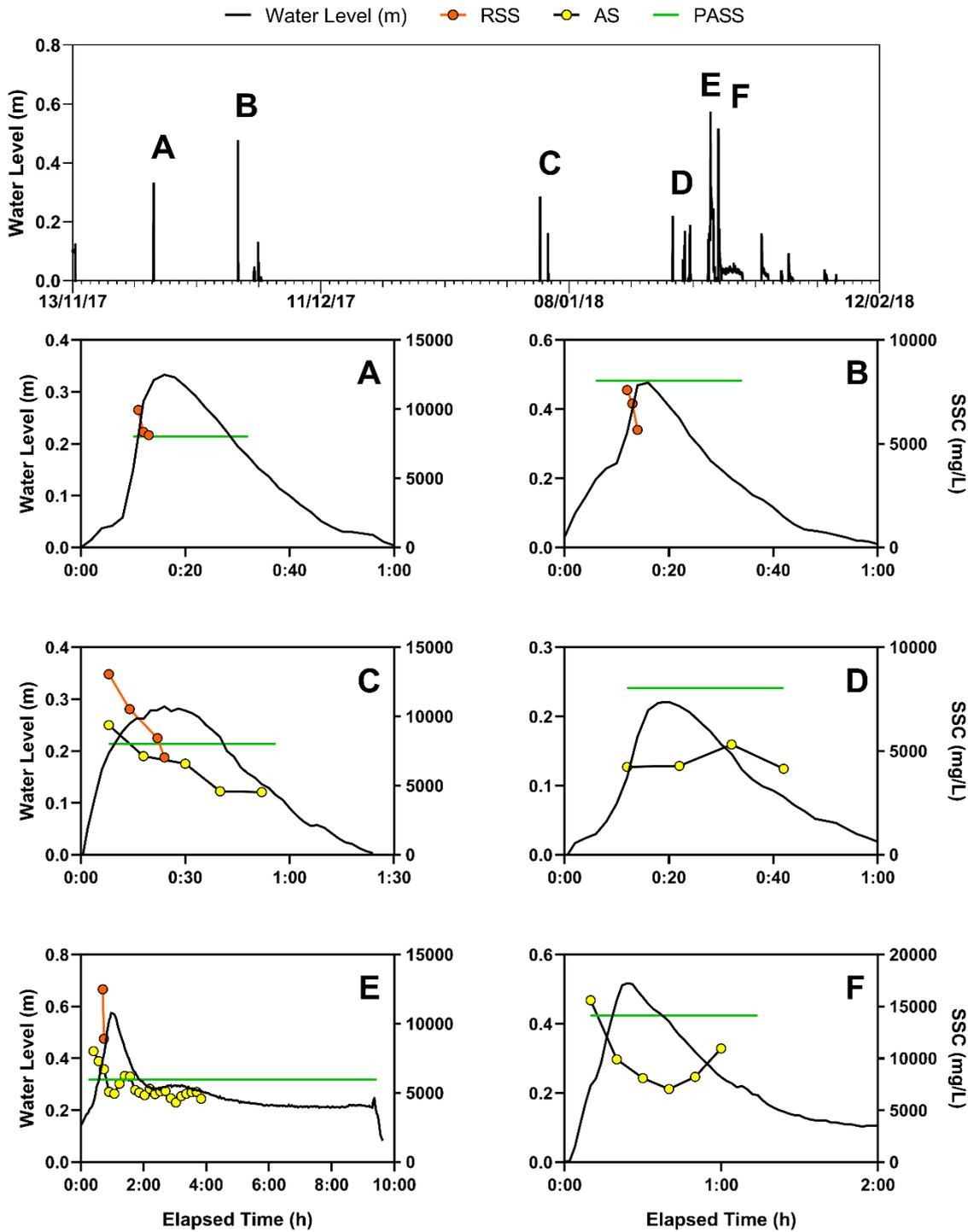


Figure SI-3A Timeline of flow events that occurred in the control gully during the 2017/2018 wet season. The top panel shows the water level for the heights for each flow event over the wet season. The individual panels show the water level (black line) and sample suspended sediment concentration data (orange = RS sampler, green = PASS sampler, yellow = autosampler, and red = flow proportional manual sampling).

SI-3

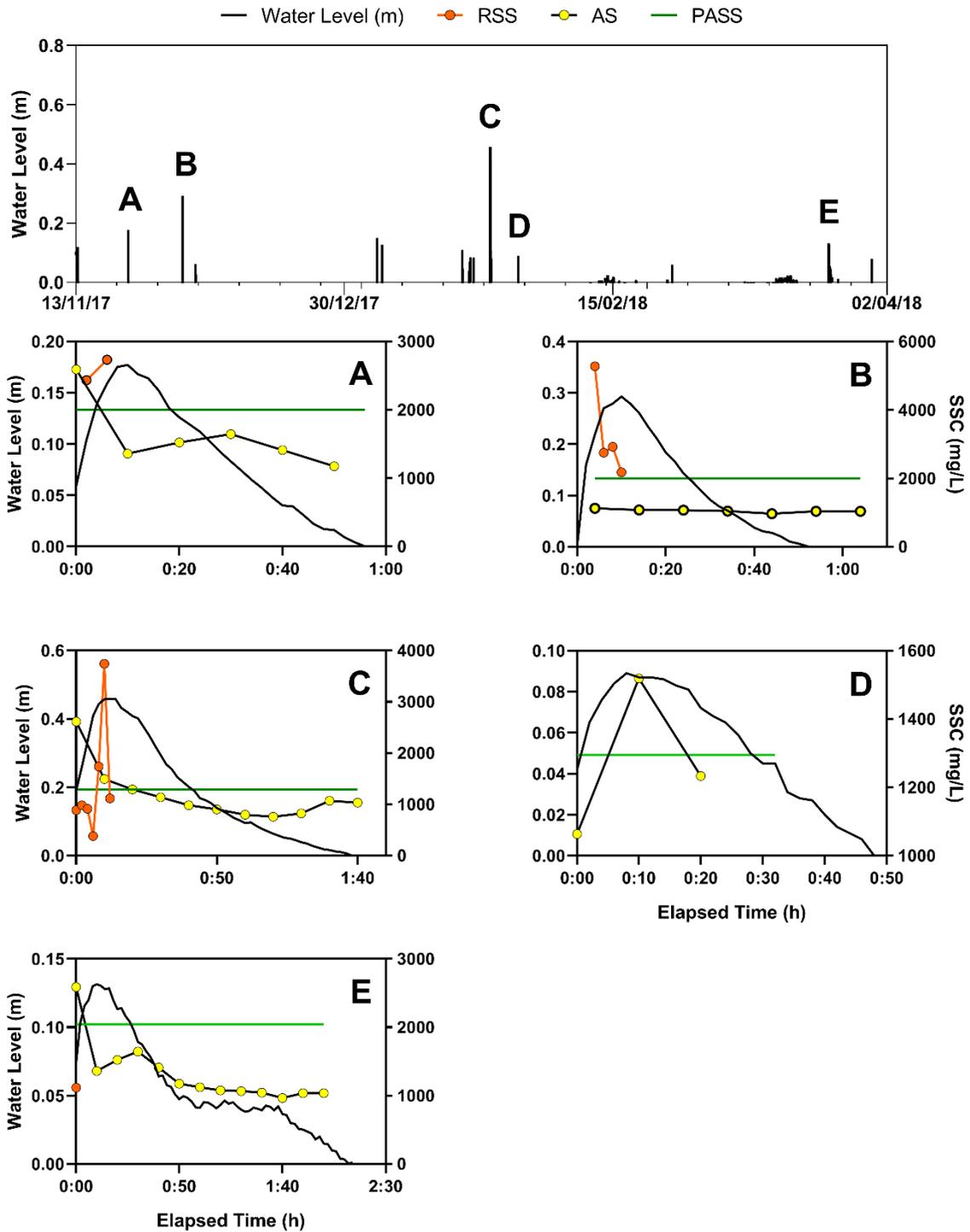


Figure SI-3B Timeline of flow events that occurred in the remediated gully during the 2017/2018 wet season. The top panel shows the water level for the heights for each flow event over the wet season. The individual panels show the water level (black line) and sample suspended sediment concentration data (orange = RS sampler, green = PASS sampler, yellow = autosampler, and red = flow proportional manual sampling).

SI-3

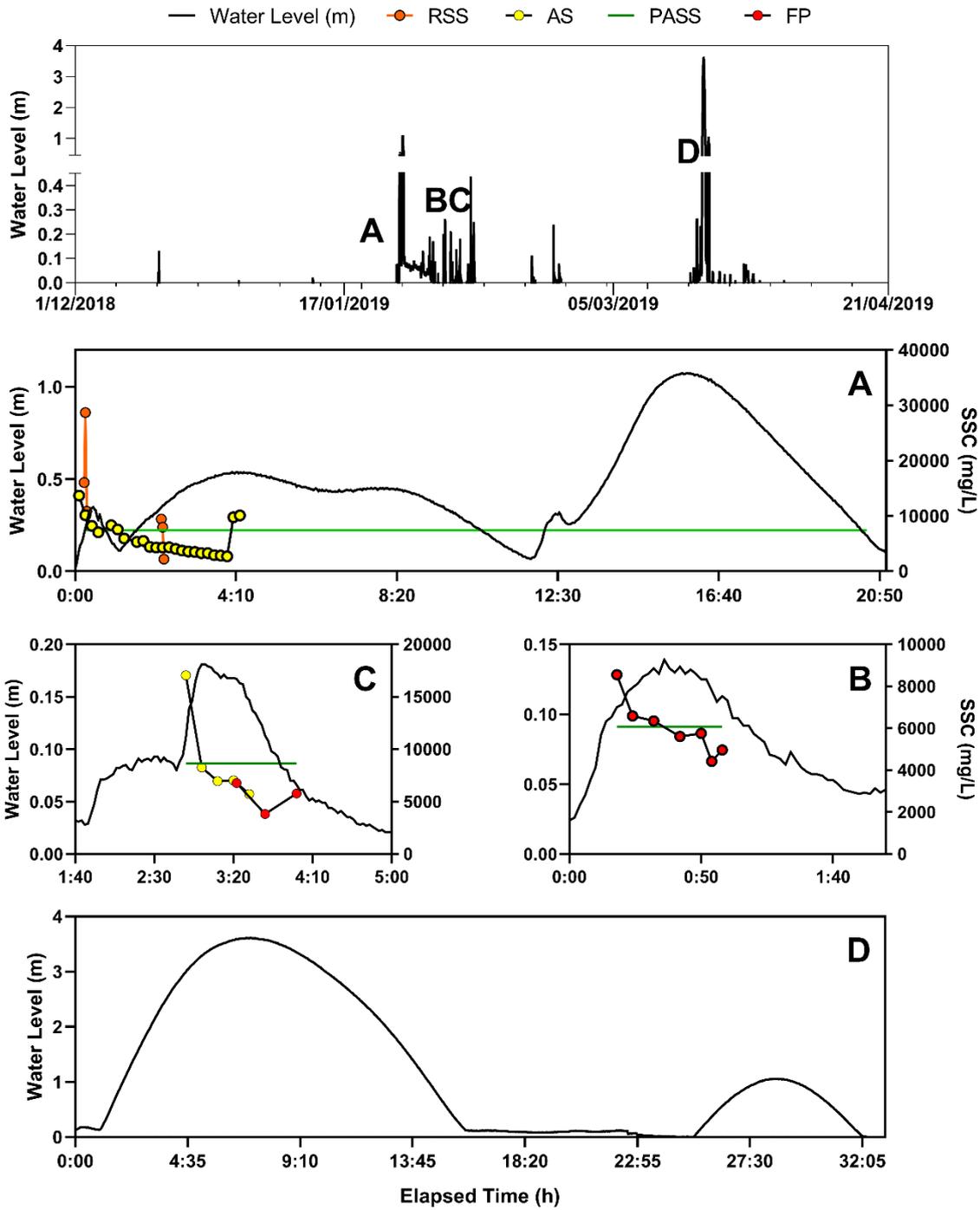


Figure SI-3C Timeline of flow events that occurred in the Control gully during the 2018/2019 wet season. The top panel shows the water level for the heights for each flow event over the wet season. The individual panels show the water level (black line) and sample suspended sediment concentration data (orange = RS sampler, green = PASS sampler, yellow = autosampler, and red = flow proportional manual sampling).

SI-3

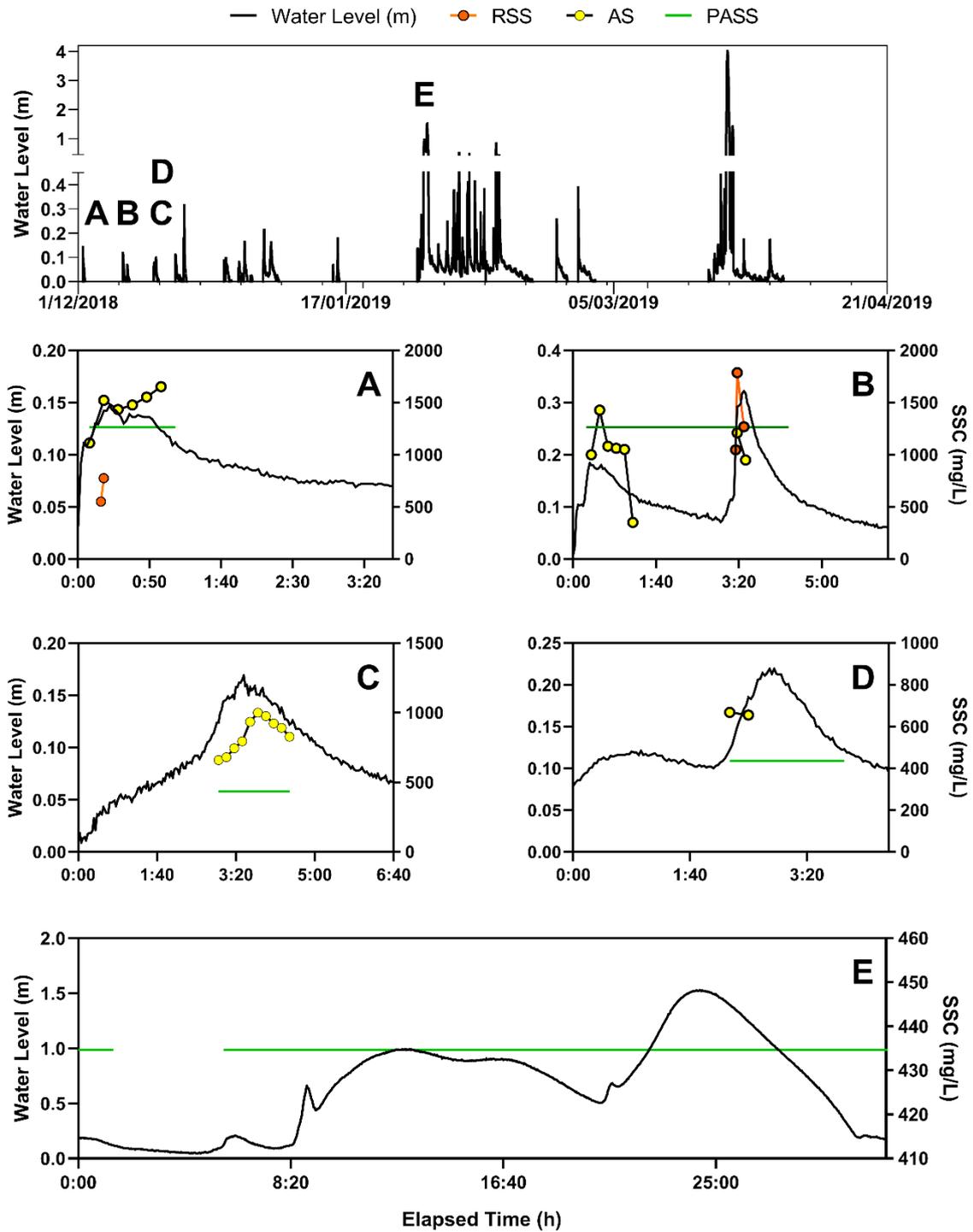


Figure SI-3D Timeline of flow events that occurred in the Remediated gully during the first half of 2018/2019 wet season (i.e., up to January 2019). The top panel shows the water level for the heights for each flow event over the wet season. The individual panels show the water level (black line) and sample suspended sediment concentration data (orange = RS sampler, green = PASS sampler, yellow = autosampler, and red = flow proportional manual sampling).

SI-3

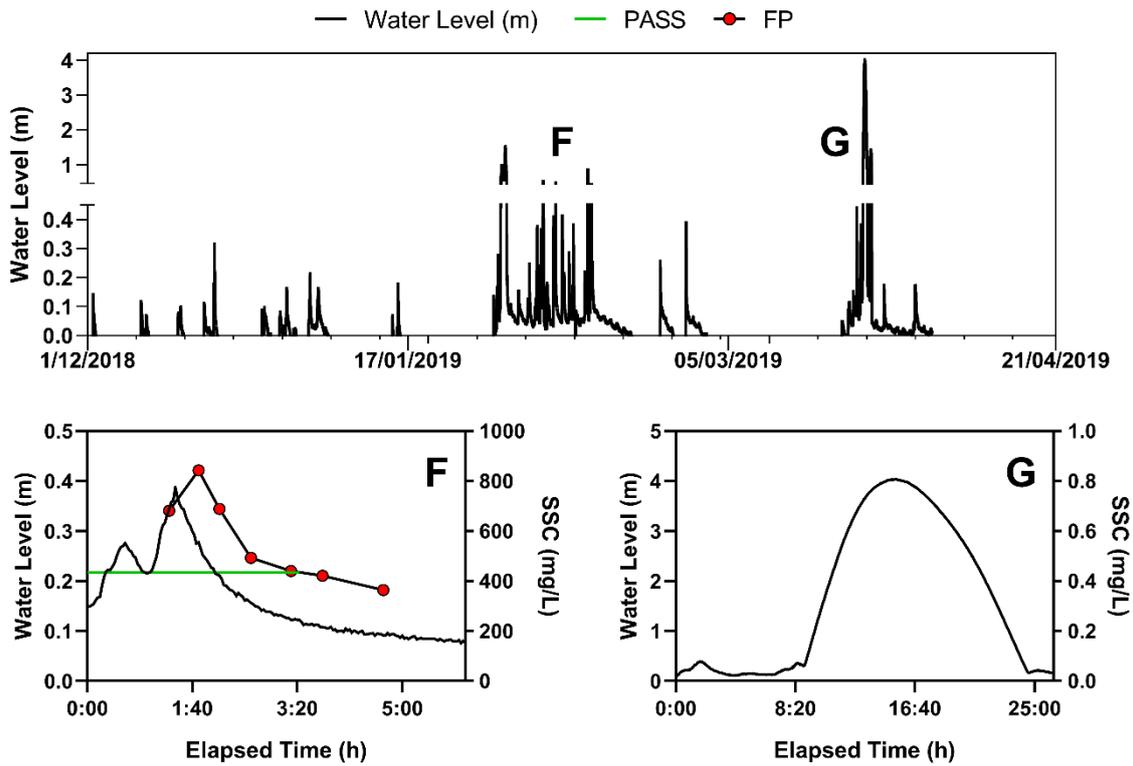


Figure SI-3D Timeline of flow events that occurred in the Remediated gully during the second half of 2018/2019 wet season (i.e., February to April 2019). The top panel shows the water level for the heights for each flow event over the wet season. The individual panels show the water level (black line) and sample suspended sediment concentration data (orange = RS sampler, green = PASS sampler, yellow = autosampler, and red = flow proportional manual sampling).

SI-4



Figure SI-4A. Infrared image of remediated gully flooded during January 2019 backwater event.

SI-4



Figure SI-4B Remediated gully during small flow event on 6 February 2019.

SI-4



Figure SI-4C: Control gully during small flow event on 6 February 2019

SI-5

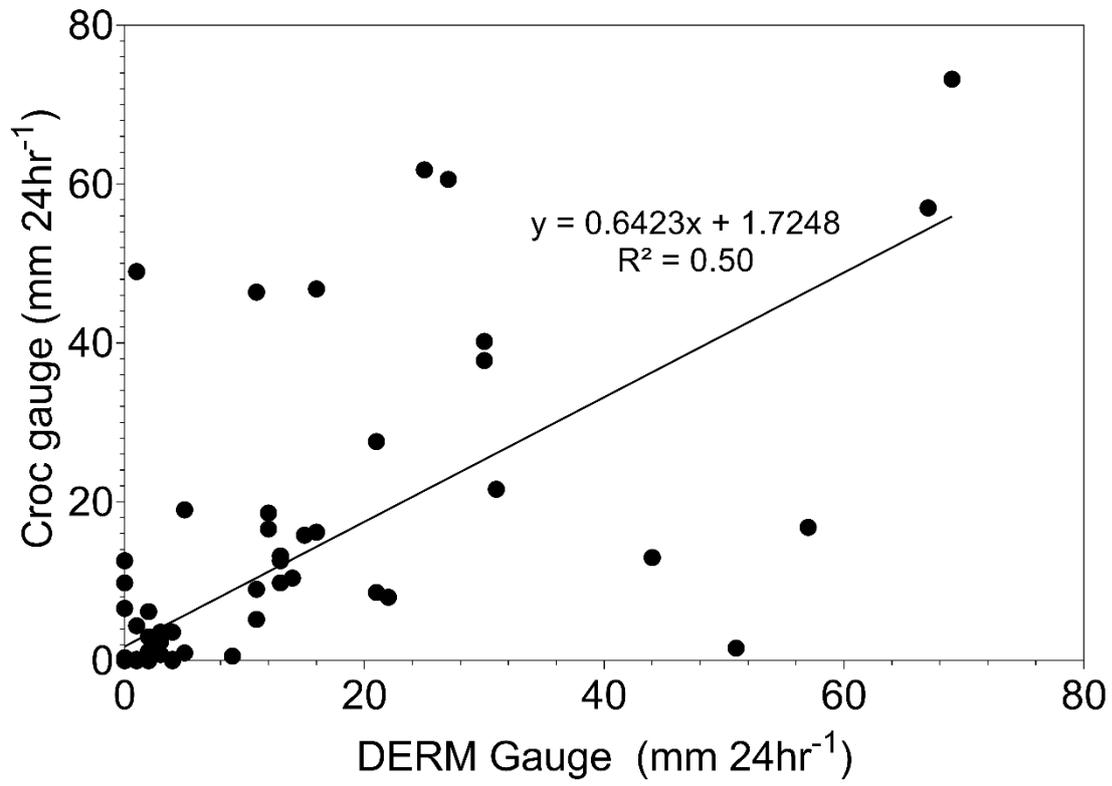


Figure SI-5. Linear correlation between daily total rainfall measured using raingauges located at the study site and the Coal Seam Creek Stream Gauge on the Laura River.

SI-6**Table SI-6. Density of gully sediment**

<i>Sample Number</i>	<i>size class (μm)</i>	<i>Density (g/mL)</i>
1	<63	2.30
2	<63	2.30
3	<63	2.26
4	<63	2.28
5	63-2000	2.43
6	63-2000	2.44
7	63-2000	2.40
<i>Average</i>		2.34
<i>Standard deviation</i>		0.08
<i>RSD</i>		3%

Please note, in-order to have enough sediment mass, density testing was conducted on gully sediment from the control gully and assumed to be comparable to remediated gully sediment, based on soil chemistry and PSD.

SI-7

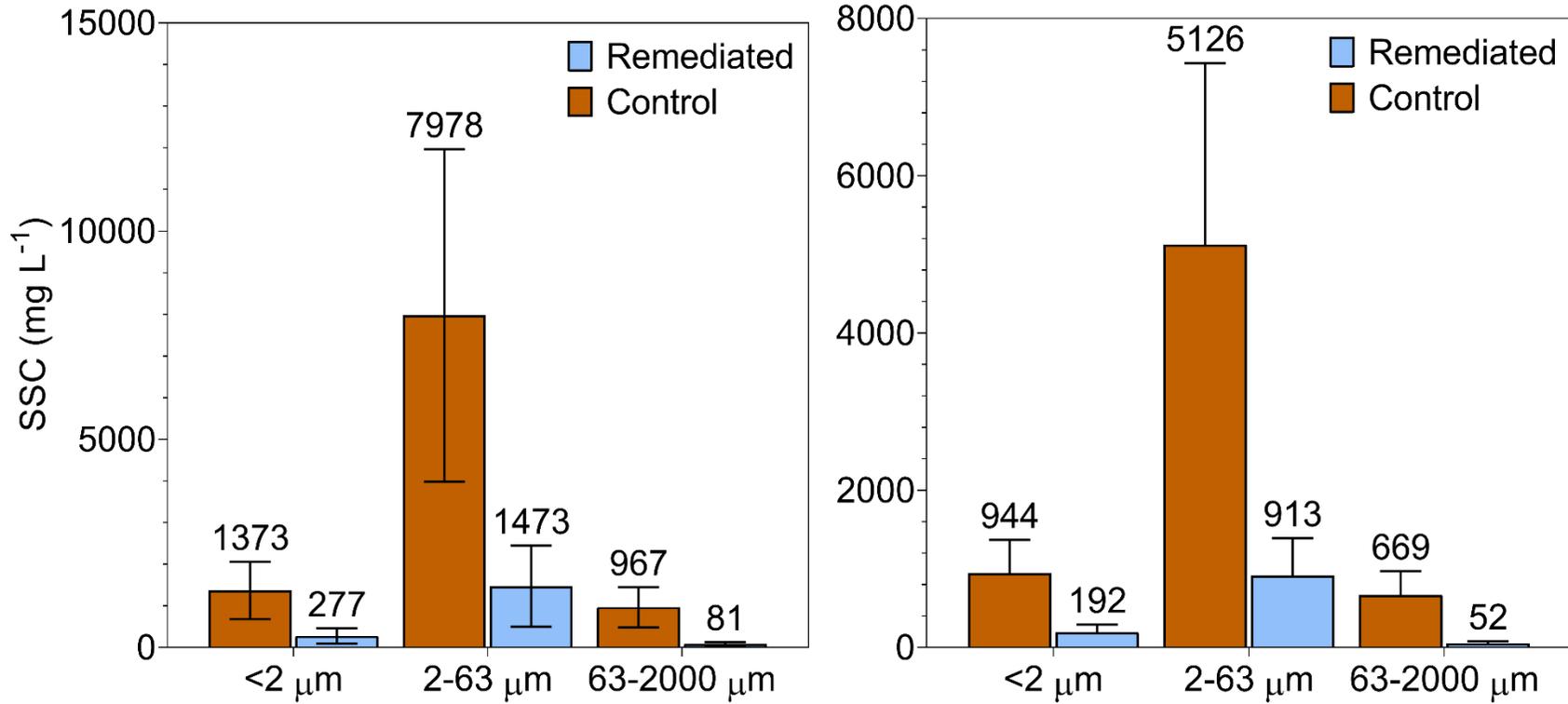


Figure SI-7 SSC by PSD for samples collected using autosamplers (left) and RS samplers (right) from the control (brown) and remediated (blue) gullies during the 2017/2018 and 2018/2019 wet seasons.

SI-8**Table SI-8. Statistical comparison of control and remediated gully soil PSD measurements.**

<i>Soil size (μm)</i>	<i>Significant?</i>	<i>p value</i>	<i>Mean of Control</i>	<i>Mean of Remediated</i>	<i>Difference</i>	<i>SE of difference</i>	<i>t ratio</i>	<i>df</i>
<i>>2000</i>	No	0.219477	2.25	0.9133	1.34	1.05	1.28	17
<i>2000-50</i>	No	0.617292	47.75	43.23	4.52	8.89	0.51	17
<i>50-20</i>	No	0.724715	61.25	57.97	3.28	9.17	0.36	17
<i>2-20</i>	No	0.699885	19.25	21.58	-2.33	5.94	0.39	17
<i><2</i>	No	0.830985	19.25	20.43	-1.18	5.46	0.22	17

SI-9



Figure SI-9A. Looking down stream at the outlet channel from control gully head. Photo taken in on 16/02/2018. Note large deposit of sand making up channel bed.

SI-9



Figure SI-9B. Looking downstream from at remediated gully head outlet channel. Photo taken in on 16/02/2018. Note the lack of sediment in the channel bed.



Figure SI-9C. Looking upstream into remediated gully at same location as Figure SI-9B. Photo taken in on 16/02/2018. Note the check dam has collected coarse sediment and now supports vegetation.

SI-10

Table SI-10A. Pearson's correlation analysis of SSC and nutrient fractions of samples collected from the control gully on 24/01/2018.

<i>Control Gully</i>							
<i>Analytes compared</i>	<i>r</i>	<i>95% confidence interval</i>	<i>R squared</i>	<i>P (two-tailed)</i>	<i>P value summary</i>	<i>Significant? (alpha = 0.05)</i>	<i>Number of XY Pairs</i>
SSC vs.Total OC	0.5985	0.2365 to 0.8146	0.3582	0.0033	**	Yes	22
SSC vs.Dissolved OC	-0.2228	-0.5890 to 0.2195	0.04962	0.3191	ns	No	22
SSC vs.POC	0.6951	0.3868 to 0.8636	0.4831	0.0003	***	Yes	22
SSC vs.Total N as N	0.7675	0.5113 to 0.8984	0.589	<0.0001	****	Yes	22
SSC vs.Organic N (dissolved) as N	-0.268	-0.6196 to 0.1732	0.07183	0.2279	ns	No	22
SSC vs.Total nitrogen (dissolved) as N	-0.3307	-0.6603 to 0.1056	0.1094	0.1327	ns	No	22
SSC vs.Total N (suspended) as N	0.7759	0.5266 to 0.9024	0.6021	<0.0001	****	Yes	22
SSC vs.Ammonium N as N	-0.1665	-0.5496 to 0.2743	0.02774	0.4588	ns	No	22
SSC vs.Oxidised nitrogen as N	-0.6403	-0.8399 to -0.2883	0.41	0.0018	**	Yes	21
SSC vs.Total Kjeldahl N as N	0.7708	0.5173 to 0.8999	0.5941	<0.0001	****	Yes	22
SSC vs.Dissolved Kjeldahl N as N	-0.2654	-0.6178 to 0.1759	0.07041	0.2327	ns	No	22
SSC vs.Total P (suspended) as P	0.6758	0.3554 to 0.8541	0.4567	0.0006	***	Yes	22
SSC vs.Organic P (dissolved) as P	-0.1788	-0.5583 to 0.2626	0.03198	0.4259	ns	No	22
SSC vs.Phosphate P as P	-0.4957	-0.7639 to -0.08144	0.2457	0.0223	*	Yes	21
SSC vs.Total Kjeldahl P as P	0.6609	0.3317 to 0.8466	0.4367	0.0008	***	Yes	22
SSC vs.Dissolved Kjeldahl P as P	-0.3086	-0.6462 to 0.1299	0.09525	0.1623	ns	No	22

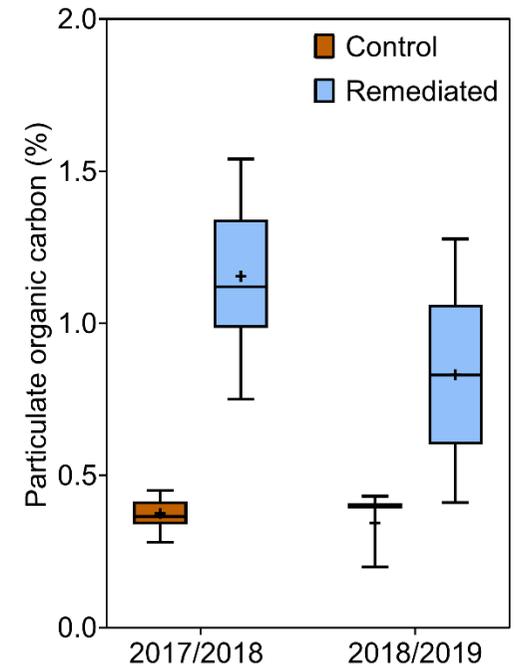
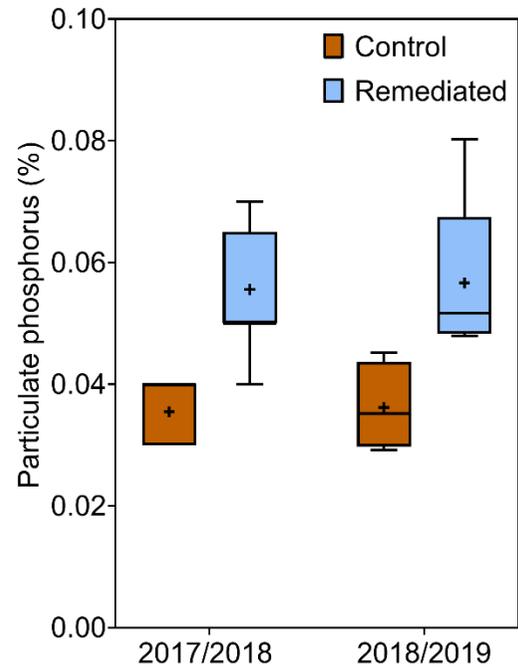
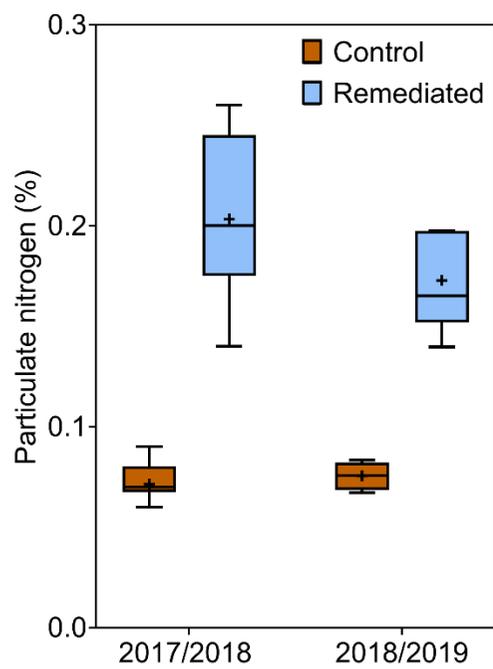
P = phosphorus, N = Nitrogen, POC = particulate organic carbon.

SI-10

Table SI-10B. Pearson's correlation analysis of SSC and nutrient fractions of samples collected from the remediated gully on 24/01/2018.

<i>Remediated Gully</i>							
<i>Analytes compared</i>	<i>r</i>	<i>95% confidence interval</i>	<i>R squared</i>	<i>P (two-tailed)</i>	<i>P value summary</i>	<i>Significant? (alpha = 0.05)</i>	<i>Number of XY Pairs</i>
SSC vs.Total OC	0.2898	-0.4636 to 0.7999	0.08397	0.4494	ns	No	9
SSC vs.Dissolved OC	0.19	-0.5426 to 0.7584	0.03608	0.6245	ns	No	9
SSC vs.POC	0.2312	-0.5114 to 0.7762	0.05347	0.5494	ns	No	9
SSC vs.Total N as N	0.4464	-0.3095 to 0.8566	0.1993	0.2284	ns	No	9
SSC vs.Organic N (dissolved) as N	0.655	-0.01613 to 0.9193	0.429	0.0555	ns	No	9
SSC vs.Total nitrogen (dissolved) as N	0.8752	0.5040 to 0.9735	0.766	0.002	**	Yes	9
SSC vs.Total N (suspended) as N	0.2812	-0.4708 to 0.7966	0.07909	0.4635	ns	No	9
SSC vs.Ammonium N as N	-0.1544	-0.7424 to 0.5680	0.02383	0.6917	ns	No	9
SSC vs.Oxidised nitrogen as N	0.7484	0.1676 to 0.9436	0.5601	0.0204	*	Yes	9
SSC vs.Total Kjeldahl N as N	0.3899	-0.3701 to 0.8372	0.152	0.2996	ns	No	9
SSC vs.Dissolved Kjeldahl N as N	0.657	-0.01269 to 0.9198	0.4316	0.0545	ns	No	9
SSC vs.Total P (suspended) as P	0.4864	-0.2626 to 0.8696	0.2365	0.1843	ns	No	9
SSC vs.Organic P (dissolved) as P	0.00184	-0.6631 to 0.6651	3.4E-06	0.9962	ns	No	9
SSC vs.Phosphate P as P	<LOD	<LOD	<LOD	<LOD	<LOD	No	9
SSC vs.Total Kjeldahl P as P	0.5362	-0.1987 to 0.8851	0.2875	0.1367	ns	No	9
SSC vs.Dissolved Kjeldahl P as P	-0.1127	-0.7227 to 0.5960	0.01271	0.7727	ns	No	9

P = phosphorus, N = Nitrogen, POC = particulate organic carbon.



SI-11. Nutrient concentration of suspended sediment presented as a percentage of SSC for samples collected during flow events in the remediated (blue) and control (brown) gullies events in the 2017/2018 and 2018/2019 wet seasons. Note, the 2017/2018 data represents a single flow event and the 2018/2019 data represent multiple flow events. Nutrient content represents the mass of particulate nutrients as a component of the total suspended sediment mass, expressed as a percentage.