THE IMPACT OF EARLY SUMMER STUBBLE FIRE

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Southern Australian crops are normally ready to harvest on the verge of a hot, dry summer and the benefits of retaining crop residues to protect the soil over summer are well established.

However, the mature crop and the straw residue left behind following harvest are combustible fuel and sometimes they get burnt during wild fire events.

This brief investigation aims to determine if there are implications for the following season when residue is burnt in the early summer.

The investigation looked at 3 pre-Christmas stubble fires where only part of the paddock was burnt and the remainder of the paddock was unburnt for comparison.

The farmer observations and supporting NDVI and Yield data suggest that future productivity can be compromised following a fire at harvest or during the early summer period.

Yorketown

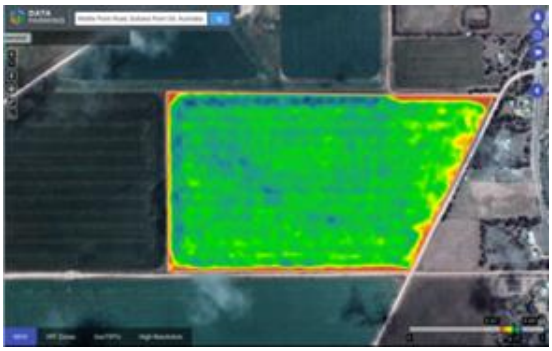
Prior to the Yorketown fire, the NDVI* plant vigour imaging captured during July and September of 2019 showed a relatively consistent crop across the paddock.

In late November 2019, the standing crop in the north-western corner of the paddock was consumed entirely by fire, while the remainder of the paddock was left intact.

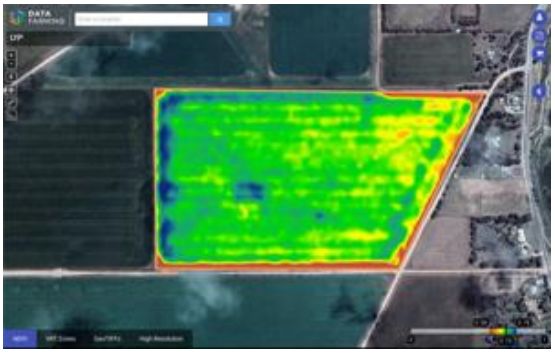
In Autumn of the following year, the paddock was sown uniformly with faba beans. The NDVI in July 2020 showed poor crop vigour over the area of the paddock that was previously burnt relative to the unburnt section of the paddock despite the same rate of seed and fertiliser being applied.

By September 2020, the crop continued to show a mild legacy of lower vigour plants and the end of season yield map from December 2020 highlighted the full extent of the fire damage a year before. The unburnt areas in the paddock produced yields of around 4.8T, whereas the area where the stubble was burnt the year beforehand was around 3.5T. That is, a 37% yield penalty in the season following the early summer stubble fire.

The NDVI in July 2021 continued to show the distinct legacy of where the stubble was burnt more than 2 years earlier.



NDVI JULY 2019



NDVI SEPT 2019

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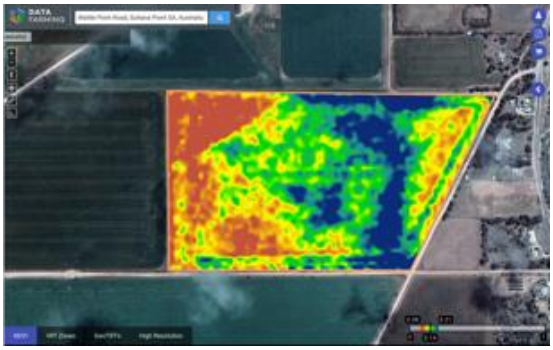
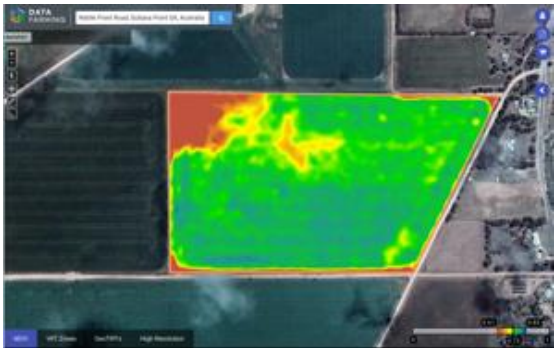
YORKETOWN FIRE 20th Nov 2019



NDVI JULY 2021



NDVI JULY 2020

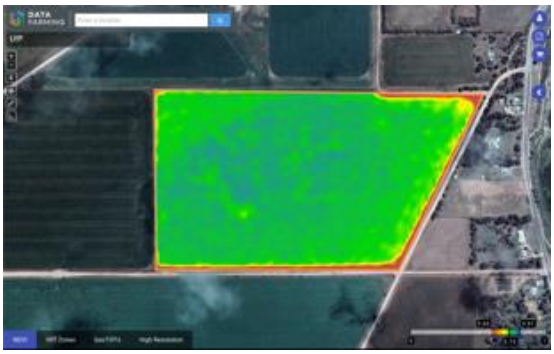
Balaklava

A lightning strike just east of Balaklava in December of 2019 sparked a stubble fire at the northern end of a paddock.

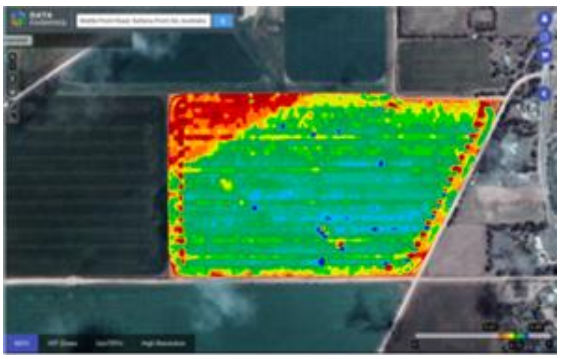
The outcome at Balaklava was similar to that at Yorketown. A discernible low-vigour NDVI signature was observed in the 2020 lentil crop during July and September over the burnt area.

The 2020 lentil yield suffered in the burnt areas (1.2T/ha) and averaged about 35% less than the paddock average (1.53T/ha), and much less than the high performing areas (2.26 T/ha).

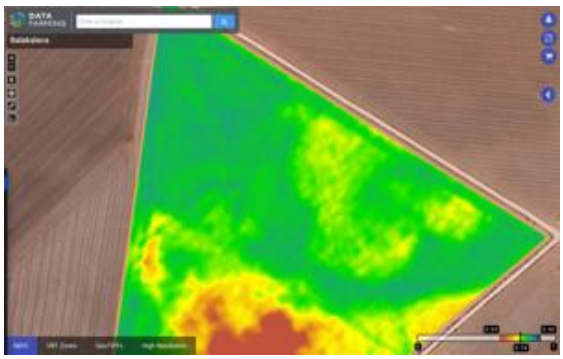
The legacy of the 2019 burn was still evident in the July 2021 NDVI image.



NDVI SEPT 2020



YIELD DECEMBER 2020



NDVI JULY 2019

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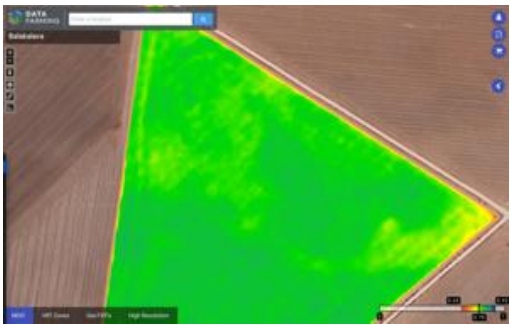
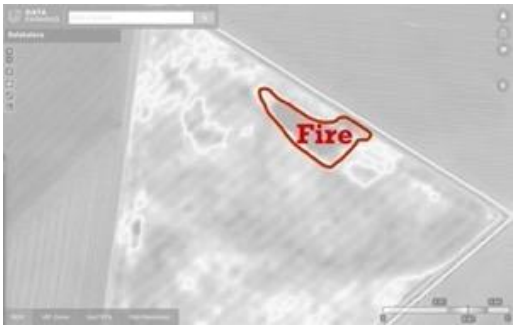
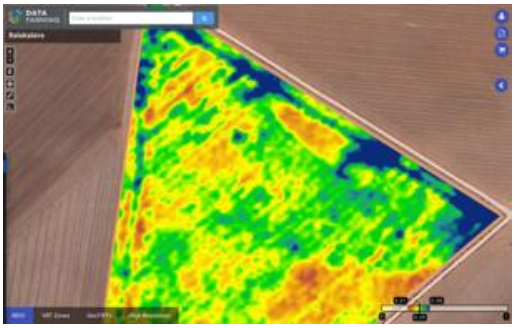


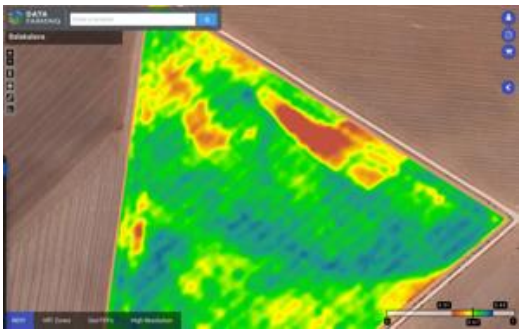
NDVI SEPTEMBER 2019



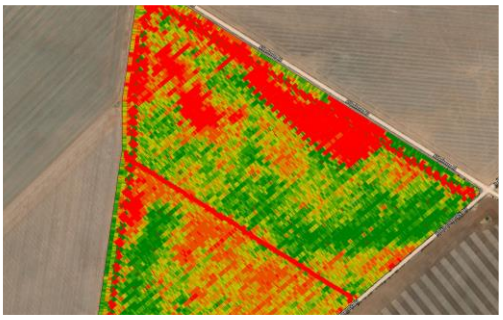
FIRE DECEMBER 2019



NDVI JULY 2020



NDVI SEPTEMBER 2020



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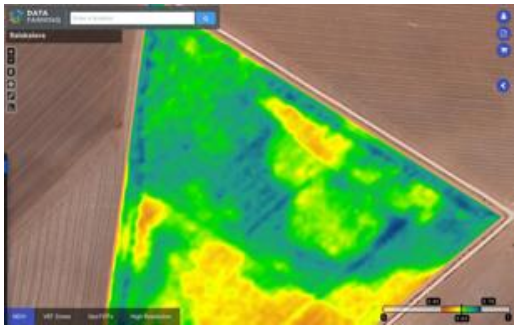
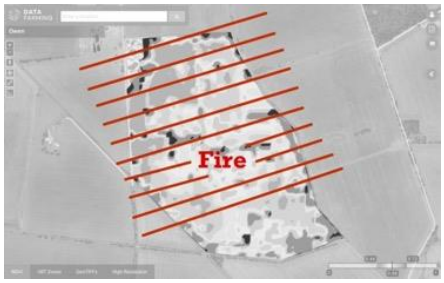


NDVI JULY 2021

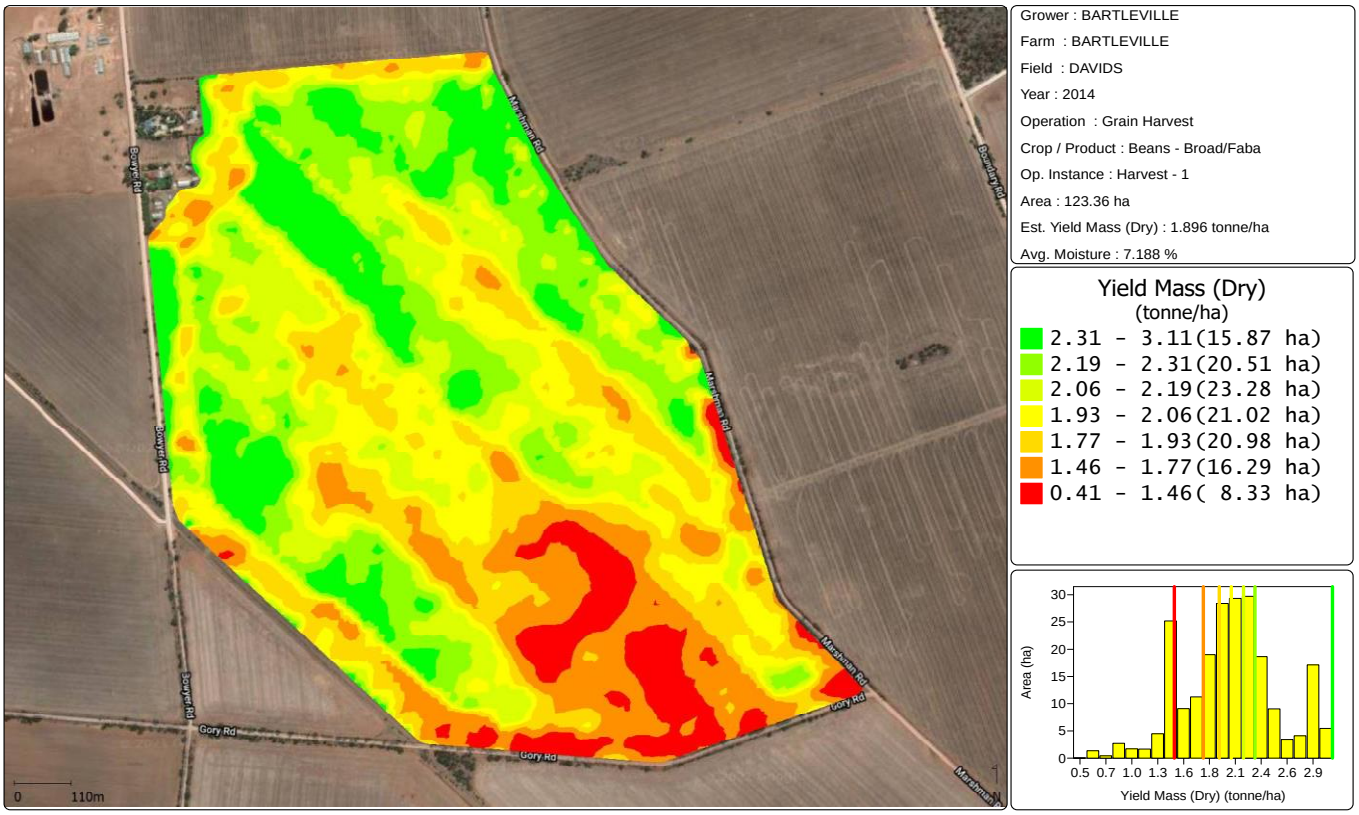
Owen

The Pinery fire burnt the northern majority of a paddock at Owen in late November 2015.
The southern end of the paddock was saved from the fire.



PINERY FIRE 30TH NOV 2015

Historically, the farm operators knew that the southern end of the paddock was noticeably lower yielding on average than the higher producing northern end, as illustrated in the 2014 yield map; the last harvest before the Pinery Fire.



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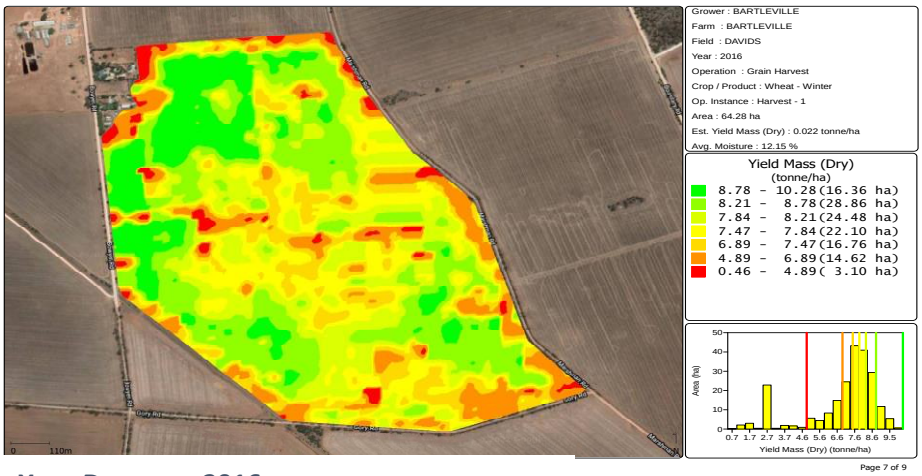
YIELD DECEMBER 2014

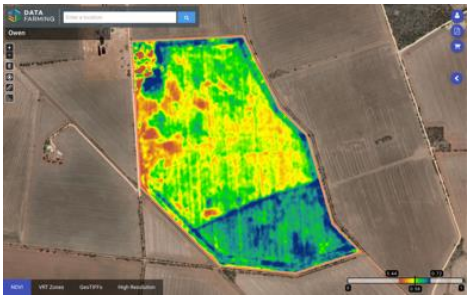
Since the Pinery Fire, the farm operators have noticed reduced vigour and yield in the northern area that was burnt.

The 2016 Yield map showed a relatively uniform harvest where the formally higher performing northern end of the paddock showed crop performance more similar to the lower performing southern end of the paddock.

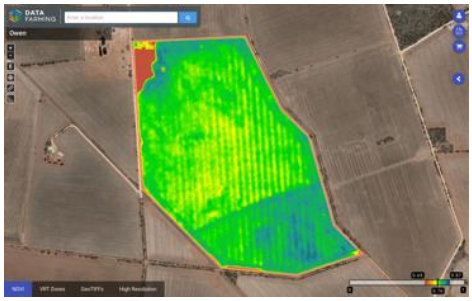


YIELD DECEMBER 2016

In season NDVI to measure vigour in 2017 showed that the historically low performing southern end of the paddock was out-performing the historically higher performing northern end.



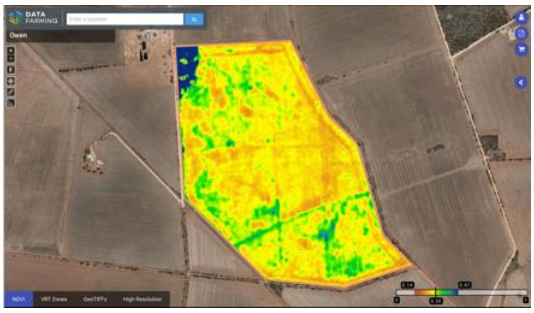
NDVI JULY 2017



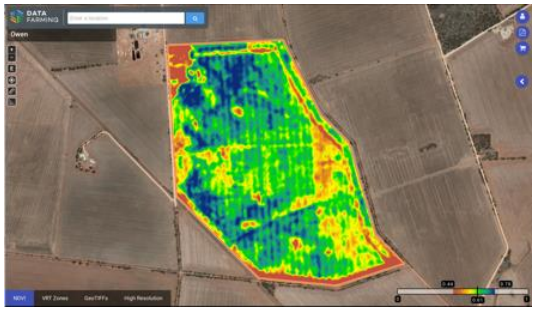
NDVI SEPT 2017

NDVI and Yield maps through 2018 and 2019 continued to show that the northern end of the paddock had not regained its historically higher performance relative to the southern end of the paddock.

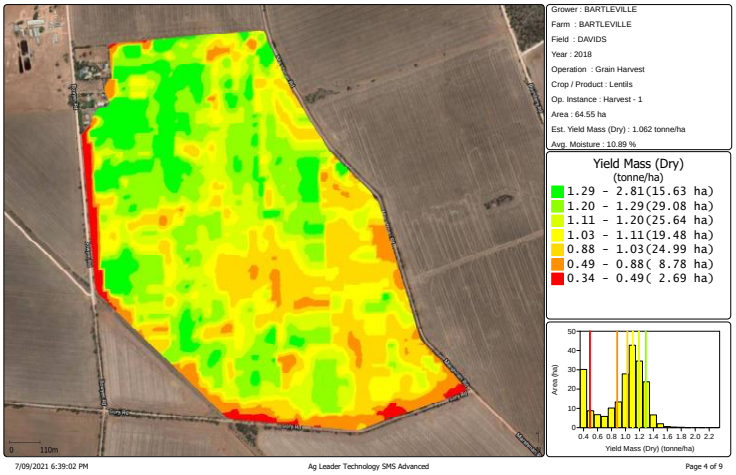
The farm operators are still aware of the damage caused by the Pinery Fire. Their opinion that the fire damage may linger for years is seemingly supported by the data.



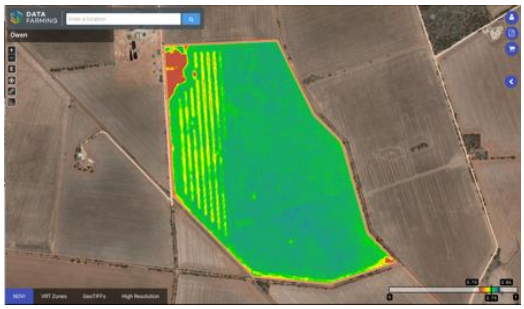
NDVI JULY 2018



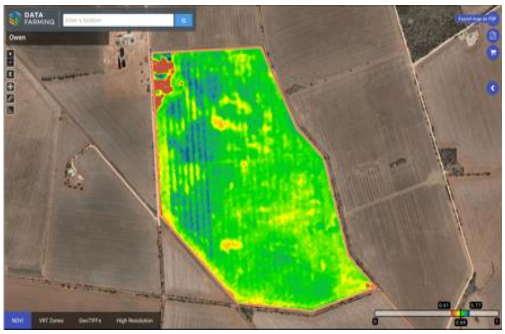
NDVI SEPT 2018



YIELD DECEMBER 2018

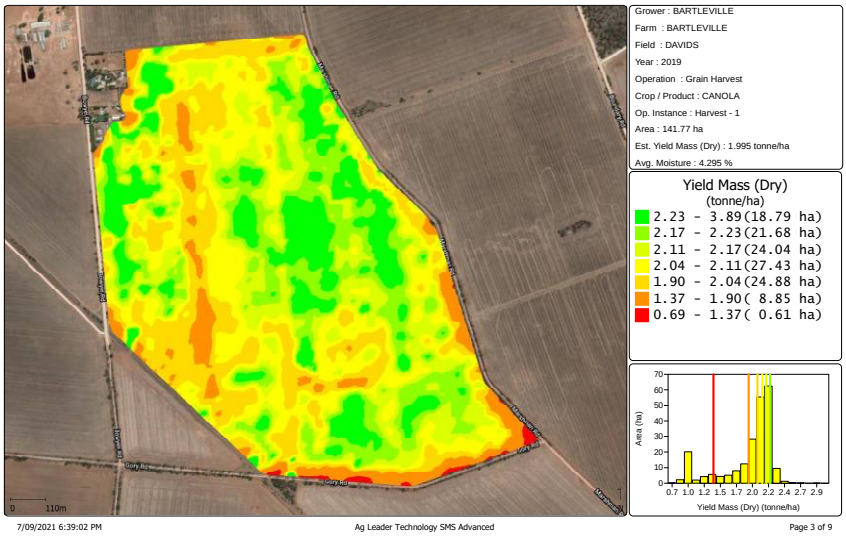


NDVI JULY 2019



NDVI SEPT 2019

As a snapshot, it appears that fires during harvest and early summer, that leave the soil bare over the long hot summer and reduces the infiltration of summer rainfall events can have an effect for the following season, and perhaps longer.



YIELD DECEMBER 2019

More work is required to determine the mechanism of vigour and yield loss however, the likely contributors are:

1) Reduced infiltration of over-summer rainfall into the soil profile due to lack of soil protection and increased run-off.
2) An increase of intense solar radiation directly on the soil, increasing soil temperature and evaporation
3) Higher exposure of the soil surface to wind, eroding topsoil nutrients and soil organic matter and further increasing evaporation potential.
4) A decrease of carbon feedstocks for soil metabolism.

If the result of an early summer stubble fire is reduced moisture in the soil profile, growers may benefit by treating the burnt areas of a paddock differently to the unburnt section.

For example, if a soil moisture deficit and corresponding lower yield potential does exist from an earlier stubble fire, reducing nitrogen fertiliser inputs for that previously burnt area may help reduce overall cropping costs.

Applying organic matter over the burnt area may help to reduce topsoil erosion and increase summer rainfall infiltration, although the cost effectiveness of this remedial action would need to be investigated.

*NDVI. **Normalized Difference Vegetation Index**

The normalized difference vegetation index is a simple graphical indicator applied in remote sensing application to analyse the relative performance of green vegetation.

Acknowledgement

This preliminary investigation to the effect of stubble fires during harvest and the early summer period was kindly supported by the South Australia Department of Environment and Water.

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