REPRESENTING BUSHFIRE IMPACTS IN SOURCE

eWater’s Source modelling provides a valuable tool to help water and catchment managers predict the impacts of the recent bushfires on river systems and water supplies.

Source has a number of rainfall-runoff models which can be directly parameterized to reflect changes to runoff volumes due to forest destruction and regrowth. Source water system

models using these can then be combined with historical climate data to assess changes in the reliability of water supply resulting from the bushfire impacts during the regrowth period. Such analyses would involve hundreds of runs of the models to reflect climate variability. Additional impacts due to climate change can also be assessed. Existing water system models developed using pre-determined inflow data can be adjusted to reflect changes in runoff behaviour described by Hill *et al.* (2008). These models can also be used to assess changes in the reliability of water supply resulting from the bushfire impacts during the regrowth period.

The Source rainfall-runoff models can also be used to assess the likely impacts on stream and water storage water quality. The models would be paramaterised according to findings of past studies (such as Sheridan, G.J. *et al*. 2007), and would inform catchment and water managers where contingency management plans are required. A precursor to Source has been used to model both the runoff volume and quality impacts of past bushfires in Australia (Murray-Darling Basin Commission, 2007; Feikema *et al.* 2011).

Water Research Australia – 2020 Catchment Forum

This year's Water Research Australia catchment forum had a focus on bushfires 'Recovery for Resilience'. eWater presented the initial findings of our analysis of the impacts of the 2003 bushfires in the ACT on water yield.

References

Feikema, P. *et al.* 2011, Estimating catchment-scale impacts of wildfire on sediment and nutrient loads using the E2 catchment modelling framework, Environmental Modelling and Software, 26, pp. 913-928

Hill, P.I. *et al.* 2008, Spatially explicit modelling of the hydrologic response of bushfires at the catchment scale, Australasian Journal of Water Resources, 12:3, 281-290, DOI:

10.1080/13241583.2008.11465354

Bushfire burning near Blowering Reservoir, NSW (Greg Brave, Adobe Stock)

BUSHFIRE IMPACTS ON HYDROLOGY

Changes to the quality of runoff

Past bushfires have resulted in significant water quality emergencies, for example:

- contamination of water supply reservoirs in Canberra's Cotter catchment, leading to disruptions to water supply and the need to construct a new water treatment plant (White I. *et al*, 2006)
- a significant fish kill due to near-zero dissolved oxygen levels in the Ovens River in north-east Victoria following a severe storm over a fire-impacted tributary (Smith, H. *et al*., 2011)

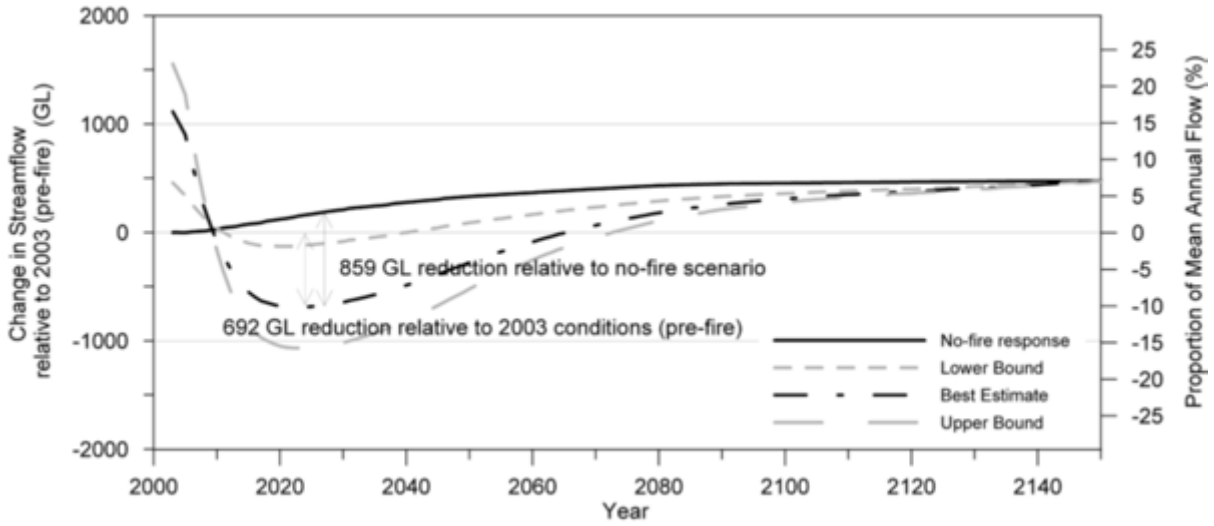
Numerous studies following past bushfires have given us a trove of data with which to predict future impacts on the quality of runoff (e.g. Sheridan, G.J. *et al*. 2007). The short term increase in runoff rates following bushfires exacerbates the risks of water quality emergencies following bushfires.

Runoff after bushfires can contain high loads of sediment, ash, debris, chemicals and nutrients (Daria Ni, Adobe Stock)

Changes to the quantity of runoff

Bushfires in Australian eucalypt forests lead to significant detrimental impacts on runoff volumes, and the quality of

runoff. Numerous studies (Langford, K. J. 1976; Kuczera, G. A. 1985; Hill, P. I. *et al.* 2008) have found that for a given rain event, runoff volumes initially increase compared with pre-bush fire rates, then significantly reduce before returning to pre-fire rates as the regrowth forest matures. This behaviour is shown below:



Projected change in streamflow relative to mean pre-2003 fire flow for the Murray River (Hill et al. 2008)

The initial responses of runoff rates to bushfire can be even more complex. Fire can make the soil hydrophobic, leading to increased rates of runoff, fire can open up cracks or root holes, leading to increased infiltration and reduced runoff rates, or ash can seal soil pores, leading to increased runoff (Sheridan, G.J. *et al.* 2007).

Destruction of the forest and canopy, and death of the trees, is the major driver of the short-term change in runoff rates, as the trees can no longer transpire, and the canopies no longer intercept rainfall. As the trees regrow and mature the leaf area of the canopies increase, and root zone becomes deeper. The increasing leaf area leads to higher transpiration rates and so reducing runoff, and the deeper root zone enables the growing forest to access water from deeper in the soil profile, also contributing to reducing runoff as the trees regrow.

Water yields decrease as vegetation recovers from bushfire, and it can take decades for yields to return to pre-fire levels (Kinglake bushfire regrowth – David Hutchinson, Adobe Stock)

References

Kuczera, G. A. 1985, Prediction of water yield reductions following a bushfire in Ash- Mixed Species Eucalypt Forest, Melbourne Metropolitan Board of Works, Water Supply Catchment Hydrology Research, Rep. No. MMBW-W-0014

Langford, K. J. 1976, Change in yield of water following a bushfire in a forest of Eucalyptus reganas, Journal of Hydrology, Vol. 29, pp. 87-114

Murray-Darling Basin Commission, Risks to Shared Water Resources, Impact of the 2003 Alpine Bushfires on Streamflow: Modelling the impacts of the 2003 bushfires on water quality in catchments in Victoria and New South Wales, 2007

Sheridan, G.J. *et al*. 2007, Quantification of hillslope runoff and erosion processes before and after wildfire in a wet Eucalyptus forest, Journal of Hydrology, Vol 323, pp. 12-28