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Prescribed burning is an important tool in forest management systems around the world. These practices can have a significant impact on soil quality and fertility which can be indicated by labile carbon (C) and nitrogen (N) pools. However, changes in soil C and N pools and their dynamics in response to the fires may be site-specific and need to be investigated for periods from short to long term. The experiment sites were located within Toohey Forest, a suburban forest located in south-east Queensland, Australia. This study aimed to investigate soil labile C and N pools in response to the time since fire comprising: immediately before and immediately after the fire; 3 years after the fire; and 5 years after the fire at three soil depths (0-5, 5-10, 10- 20 cm). This study indicated that both water soluble organic C (WSOC) and water soluble total N (WSTN) were more sensitive and longer lasting than the other soil labile C and N pools (including soil mineral N, potentially mineralisable N, microbial biomass C and N, and soil respiration). Multiple regression analyses showed that the time since fire contributed more to water soluble organic C (WSOC) and water soluble total N (WSTN) than to hot water-extractable organic C (HWEOC) and hot water-extractable total N (HWETN). The results also revealed the significant short-term impact of fire on soil labile C and N pools, N availability, and soil microbial biomass and activity. We concluded that WSOC and WSTN were the most sensitive indicators of the responses of soil labile C and N pools to prescribed burning under these conditions. The low intensity of prescribed fires may account for the rapid recovery of labile C and N pools. The seasonal variations in this study were also revealed. This study improves our understanding of how the common forest management practices of prescribed burning might affect soil quality and fertility, highlighting important implications for the frequency of prescribed fires in such suburban forests.