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The impact of stormwater management ponds on downstream water quality

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Stormwater management (SWM) ponds are ubiquitous design features across urban critical zones, storing and delaying the export of runoff from the impervious cityscape to downstream water courses. While the efficacy of SWM ponds in attenuating flood pulses is well established, there is increasing evidence that these engineered systems serve as reactors and transformers of many water quality parameters. The storage of urban-sourced, nutrient-rich water in these shallow water bodies has been shown to lead to greatly increased water temperature, algal blooms and increases in organic nitrogen and phosphorus, subsequent dissolved oxygen depletions, and lowered redox states to levels favouring release of soluble reactive phosphate. The impact of these transformations on effluent water quality to downstream urban critical zone water courses, however, has not been well documented. This study measures outflow water quality from four SWM ponds from Ontario, Canada, relative to upstream and downstream water quality to determine the impact of these ponds on urban stream water quality.

The studied SWM ponds ranged from ~0.25 to 13 ha in area, with catchment areas of 500 to 1,100 ha consisting of 24 to 73 % impervious cover. Pond water quality was often significantly different from stream values; however, weekly sampling revealed little impact on water quality metrics. For example, while dissolved oxygen (DO) from the largest, deepest pond was near anaerobic, this effluent resulted in a significant, but small, 1 mg/L decrease in stream DO. None of the other receiving streams were significantly impacted. The SWM pond effects on stream dissolved metal concentrations were even lower: pond effluent served to dilute stream cadmium and zinc levels in the largest pond, with no other effects detected for any of the other 12 metals tested or with any of the smaller ponds. Summer stream temperature was found to increase by only 0.5 degrees due to discharge from the largest pond, with less impact in other seasons and ponds. Results of this study demonstrate that while there is significant transformation of urban surface water as it moves through a SWM pond, the impact of that water on downstream water quality is quite limited.