The carbon budget of a constructed boreal plains wetland.

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Oil sand mining in the boreal planes of Canada has been predicted to release stockpiled carbon from disturbed peatlands and permanently degrade the carbon sequestering capacity of the landscape (Rooney et al. 2012). The Sandhill Fen Watershed (SFW) is a pilot watershed built on soft tailings in an infilled pit mine to reclaim lost peatland services. It was constructed between 2009 and 2012 and is composed of 60 ha of mixed upland and lowland ecosystems. This analysis presents the first six years of carbon cycling using a mix of DOC pore-water samples, eddy covariance techniques and chamber measurements. At first, the lowland region rapidly shifted to an annual sink of CO_2, having an annual Net Ecosystem Exchange of 77 g C-CO_2 m-2 by the third year, while maintaining comparable rates of GPP to the reclaimed upland regions. Unlike the uplands however, the lowlands had much lower rates of heterotrophic respiration. This suggests that the design of the ecosystem maintained the salvaged peat in sufficiently anoxic conditions to limit decomposition. However, shifts in the vegetation towards marshland associated species altered the seasonality of photosynthesis has resulted in delayed spring uptake and the lowlands returning to an annual net source of carbon to the atmosphere. Methane emissions have continued to be suppressed over all six years despite organic material in anoxic conditions. The suppressed methane is likely due to competition from sulphate- and metal-reducing bacteria. Over the same period, DOC is increasing in the SFW pore water, but with limited outflow pathways to the surrounding landscape, it is likely not a major carbon flux out of the ecosystem.