## Results

### Soil Analyses

In total eighteen eroding bank sediment cores, and eighteen channel deposit samples were obtained for analysis and were assessed to determine their TP content and bulk density. All confidence intervals for soil analyses are reported in terms of standard error. According to an ANOVA test, both sets of samples showed significant variation in TP content by stream order. For erosional samples, first order samples had the lowest mean TP content (245 ± 20 mg/kg), and fourth order samples had the highest concentration (587 ± 66 mg/kg). In general eroding bank TP content increased from first to fourth order, then decreased from fourth to six. Both fifth and sixth order cores had TP that was less than third order, but greater than second order. Depositional samples generally decreased in TP content from first (505 ± 72 mg/kg) to sixth order (235 ± 40). There was no significant difference in TP content between erosional and depositional samples, but depositional samples had higher TP content in first and second order samples, and lower TP content in all other orders.

Unlike TP content, there was a significant difference in bulk density between erosional and depositional samples. On average, erosional samples were 3.5 times denser. While this is a large difference, this is not surprising since the erosional samples are made of Holocene alluvial and glacial materials that have undergone a high degree of compaction, and the deposition samples represent relatively young, freshly eroded sediments that are unlikely to have experienced any significant compaction since their deposition. Variations in bulk density by stream order were also significant for both sample types. For erosional samples, the highest average bulk density was in first and sixth orders (1.29 ± 0.3 and 1.30 ± 0.4 g/cm3 respectively), and the lowest average bulk density was found in the fourth order (1.15 ± 0.3 g/cm3). The peak in TP content and a low point in bulk density average within the fourth order erosion samples is an interesting result of this analysis. The depositional samples displayed a steady increase in average bulk density with increasing stream order from first (0.26 ± 0.02 g/cm3) to fifth (0.40 ± 0.1) order, but slightly decreased from fifth to sixth order.

### AIMM results

Our initial investigations of the AIMM results within the first and second order reaches of the Nishnabotna river system suggested that the one-meter resolution of the imagery combined with the relatively narrow width and large influence of canopy cover led to inaccurate results within these reaches. Consequently, we decided to exclude these reaches from our analysis, and will focus on stream orders three and above for the remainder of this paper.

Sediment volume contribution also varied significantly by order. Total depositional volume increased from third to fourth order reaches, but then decreased in orders five and six. While depositional volume was greatest in fourth order reaches, deposition had the largest proportional impact in third order reaches, where depositional volume was 92% of erosional volume. Conversely, erosional volume was smallest in third order reaches, was relatively similar in third and fourth order reaches, and the largest in sixth order reaches. Overall, the sixth order was by far the largest contributor of sediment by volume, having both the largest volume of erosion, and lowest volume of deposition. This resulted in sixth order reaches contributing 67% of the net sediment export. These general trends are also found when export is assessed in terms of mass and TP load. The relative contribution of deposition is minimized however due to the large difference in average bulk density between erosional and depositional samples.

During the nine-year study period, our analysis estimates that river migration contributed a net sediment volume of 1.17e7 ± 0.47e7 m3 to the Nishnabotna River system. When combined with our soil analyses, this corresponds to a net input of 1.81e7 ± 0.57e7 Mg of sediment and 8.26e3 ± 2.5 Mg of P. While a full sediment budget is beyond the scope of this paper, the results of the Iowa Daily Erosion Project (IDEP), an event-based implementation of the WEPP model for Iowa, can be used as contextualize for these results. For the same time period, the IDEP model estimates that the total mass of surface erosion within the Nishnabotna River system was 8.95e7 Mg, which when combined with a sediment delivery ratio of 33%, results in a total sediment contribution from on-field erosion of 2.95e7 Mg. Assuming that these were the only two sources of sediment contribution to watershed, channel migration represented 28% of the total sediment mass contribution during the study period.