geoconvention
Virtual Event
September 21-23
2020
CSPG · CSEG · CWLS · GAC · MAC · IAH

Characterization of Nutrient and Sediment Transport within a Clay Basin

Scott Gardner, Andrew D. Binns, Jana Levison, Ivan O'Halloran
School of Engineering, University of Guelph

Phosphorus contamination of groundwater and surface water resources is an important research issue according to the provincial government, which has set a goal to decrease soluble and total phosphorus by 40%. Phosphorus is readily adsorbed to sediments, and delivery of phosphorus downstream via sediment transport processes is a poorly understood mechanism fluvial systems. Sediment transport is a highly variable process which can depend on factors which vary on a multitude of spatial and temporal scales. Therefore, it is necessary to develop predictive models which can describe phosphorus transport through a watershed system under variable environmental conditions. Such a predictive model requires field-based data to inform outputs and to calibrate the model to match real world variability. The objective of this research is to develop and initiate a field data collection framework for the construction of a sediment transport model which describes phosphorus transport through an agriculturally dominated watershed in rural southwestern Ontario.

The watershed which is the focus of this research is the Upper Parkhill creek watershed, which is a sub-watershed within the Ausable Bayfield watershed located near the city of London Ontario, Canada. The Upper Parkhill creek watershed is a clay dominated low relief area where the watershed is split into two sections based on the location of the Wyoming moraine: north of the moraine the creek is heavily modified by artificial straightening and dredging, while to the south the creek is more natural in form and surrounded by naturalized area. The most hydrologically significant aspect of the watershed is the presence of artificial drainage on agricultural fields (over 70% over the area is artificially drained). In natural areas, the creek is sinuous in nature and incised deeply into the landscape. Preliminary studies of the morphology of the creek indicate that within naturalized areas the creek will migrate across the floodplain altering course on the order of approximately 20 meters per decade. It is evident that sediment transport is a significant factor at this study site. Therefore, in order to capture the spatial and temporal variability of these processes a multi-faceted sediment sampling regime is implemented. Suspended load and bed load sediments are sampled using novel industry proven techniques, bed material is sampled using specialized equipment (AMS coring system Fig. 1). Sampling locations were selected carefully with the intent to balance ease of access, safety, and watershed variability. Surface water and groundwater are also sampled at these locations to inform the model of aqueous phase phosphorus. The five sections of the creek sampled (Fig. 2) illustrate the three characteristic landscapes of the total watershed, starting from the north, the highly artificial drainage and agricultural dominated zone, the southern zone which is naturally dominated surrounding the creek and morphologically active, and a transition zone in between these two distinct areas where aspects of both meet and influence flow and morphological characteristics. Samples are collected on a monthly basis in order to capture seasonal variability, and intertwined into monthly sampling are quarterly high spatial resolution samples where multiple locations (approximately 20 locations in total) along the creek are sampled for sediment and water. All parameters collected in this study are described in Table 1. The specifics of sampling methods are discussed along with QA/QC methods to be used when challenges arise.

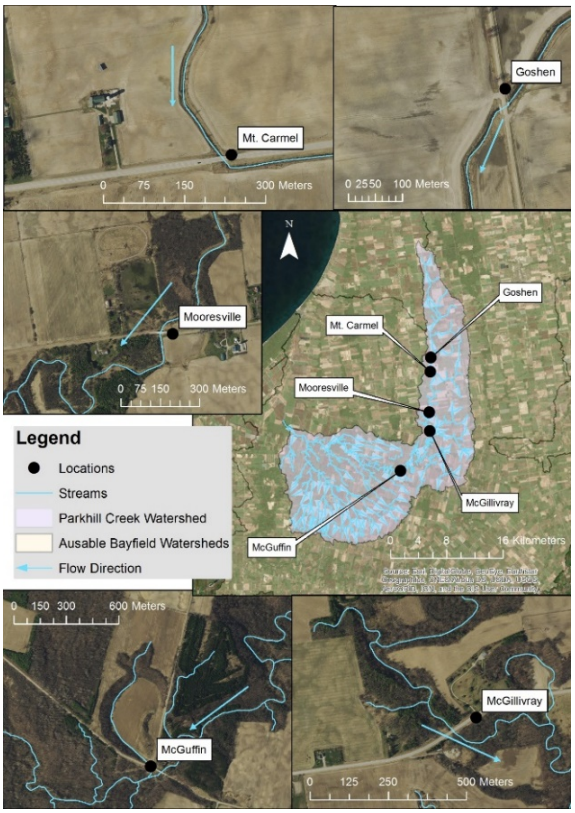

Figure 1 (left) – Site maps with sampling locations – (Above) AMS sediment core sampler

Table 1 Primary parameters measured in this study with descriptions

Parameter (medium)	Abbreviation	Purpose of collection
Total Phosphorus (water)	TP	Characterized as a measure of all forms of phosphorus in a sample. This parameter is helpful in assessing trophic state of a lake or stream.
Soluble Reactive Phosphorus (water)	SRP	Chemically active form of phosphorus, and is the primary form used by plants and used in fertilizer.
Total Dissolved Phosphorus (water)	TDP	A combination of both organic and inorganic forms of phosphorus in solution. This includes the organic forms of phosphorus which are missed by the SRP measurement.
Nitrate as N (water)	NO_3	This parameter is indicative of the amount of nitrogen which is available for plants and algae to uptake.
Total Phosphorus (sediment)	TP	Like TP in water however in sediments it represents the potential phosphorus which could reenter water through chemical processes under anoxic conditions.
Leachable Phosphorus (sediment)	LP (Olsen)	This represents the amount of inorganic phosphorus in soil or sediment which is available to plants and algae and is a common measure of fertility.

Acknowledgements

This research is supported by the Ontario Ministry of Agriculture.