Catchment	Change in HER per mm change in precipitation			% surface runoff		% soil matrix flow		Soil water residence times (days)	Clay Content (%)
	2030	2070	Average	2030	2070	2030	2070		
Holland	0.5	0.6	0.5	6.1	5.7	93.9	94.3	3.00	8.3
Pefferlaw	0.8	0.9	0.9	12.3	11.2	87.7	88.8	2.7	12.6
Beaverton	0.9	1.0	0.9	16.1	31.8	83.9	68.2	2.4	27.5
Whites	0.9	1.0	0.9	22.6	31.6	77.4	68.4	1.4	41.9

Table 1 (Table 7 in manuscript): Calculation of quantity of HER (mm) generated per mm of precipitation *(1 d.p.),* and comparison with catchment characteristics (hydrological and soil typology)

Catchment	Season	Projected change in TP (mg/l) per mm of change in precipitation	Proportion of annual change (%)	Clay content (%)
Holland	spring	0.01	6.7	
	summer	0.02	27.6	
	autumn	0.05	**61.1**	
	winter	>0.01	4.6	
	Annual Average	0.02	100	8.3
Pefferlaw	spring	0.01	11.7	
	summer	0.02	**56.1**	
	autumn	>0.01	9.5	
	winter	0.01	22.7	
	Annual Average	0.01	100	12.6
Beaverton	**Spring**	0.20	**86.2**	
	Summer	0.01	2.1	
	Autumn	0.01	5.8	
	Winter	0.01	5.9	
	Annual average	0.06	100	27.5
Whites	**spring**	0.03	5.0	
	summer	0.01	1.0	
	autumn	0.02	3.2	
	winter	0.52	**90.9**	
	Annual Average	0.14	100	41.9

Table 2 (Table 9 in manuscript): Estimation of average catchment sensitivity of water quality to uncertainty in precipitation: projected change in TP (mg/l) per mm change in precipitation averaged over 2030's and 2070's *(2.s.f.)*

Parameter	Data description	Study Site				Data Source
		Holland	Pefferlaw	Beaverton	Whites	
Catchment characteristics	Catchment area (km2)	613.8	444.4	325.3	85.0	Modelled using a 2m vertical resolution DEM (Global Land Cover Facility; 2002)
	Number of sub catchments	39	41	30	23	
	Quaternary Geology (% clay composition)	8.3	12.6	27.5	41.9	Catchment average calculations from GIS maps derived from Agriculture and Agri-Food Canada (2010)
Hydrological characteristics	Temperature (oC) daily data	7.4	7.3	7.3	7.3	Measurements from local Environment Canada meteorological stations
	Precipitation daily data	2.5	2.5	2.5	2.0	
	SMD (mm)	42.8	48.0	47.2	22.1	Derived from HBV model
	HER (mm)	0.5	0.9	1.1	0.7	
	Soil water residence time (days)	3.0	2.7	2.4	1.4	Calculations from flow hydrographs derived from field monitoring data (Dave Woods, *personal communication;* LSRCA 2010*;* LSEMS 2010; PWQMN, 2009)
	Saturation excess threshold (m^3/s)	0.6	3E-2	0.5	0.5	
	Flow-velocity relationship (flow a and b parameters)	a: 6E-2 b: 0.70	a: 5E-2 b: 0.20	a: 8E-2 b: 0.67	a: 6E-2 b: 0.7	Derived from monitoring data (Dave Woods, *personal communication;* LSRCA 2010*;* LSEMS 2010; PWQMN, 2009)
P budget in non-intensive Agriculture	Fertiliser inputs from grazing animals and applications to crops (kg/ha/yr)	33.2	32.4	30.0	25.8	Calculations using data from Statistics Canada (2011); OMAFRA (2009); Bangay (1976) using methods of Wade et al (2007b)
	Septic tank inputs (kg/ha/year)	1.2	0.8	0.2	0.2	Calculations based on data from Statistics Canada (2011) and Scott et al (2006);using methods of Paterson et al (2006) and Stephens (2007)
	Maximum Plant Uptake (kg/ha/year)	100	100	100	100	Based on previous INCA applications to the Simcoe region by Jin et al (2013)
P budget in intensive Agriculture	Fertiliser inputs from grazing animals and applications to crops (kg/ha/yr)	21.2	24.0	32.5	32.4	Calculations using data from Statistics Canada (2011); OMAFRA (2009); Bangay (1976) using methods of Wade et al (2007b)
	Maximum Plant Uptake (kg/ha/year)	100	100	100	100	Based on previous INCA applications to the Simcoe region by Jin et al (2013)
P inputs to whole catchments	Atmospheric Deposition: regional values (kg/ha/yr)	0.21	0.21	0.21	0.21	Regional monitoring data (Ramwekellan et al., 2009)
	Groundwater TDP concentration (mg/l)	7E-3	6E-3	1E-1	7E-7	Based on information from the Provincial Groundwater Monitoring Network (PGWMN, 2014)
Sewage (STW) P inputs to river reaches	Number of STWs	3	1	2	N/A	XCG consultants Ltd (2010) and KMK consultants (2004)
	Average Inputs (kg P/year)	103.6	102.9	67.2	N/A	

Table 3 (table 2 in manuscript): Details of key parameters and data sources used in model calibration (to 1 d.p)

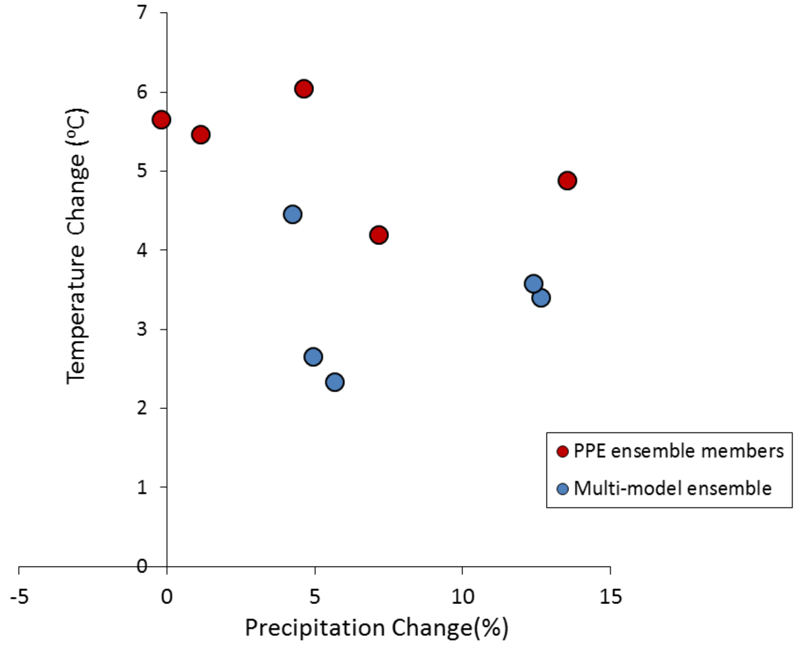

Figure 1: Scatterplot showing projected average annual change in temperature (°C) and precipitation (%) between 1968-1997 and 2060-2089. Global climate models included in the multi-model ensemble are NCARP, ECHO, ECHAM5, CSIRO, CGCM3 and CSRIOs of the A1b scenario).

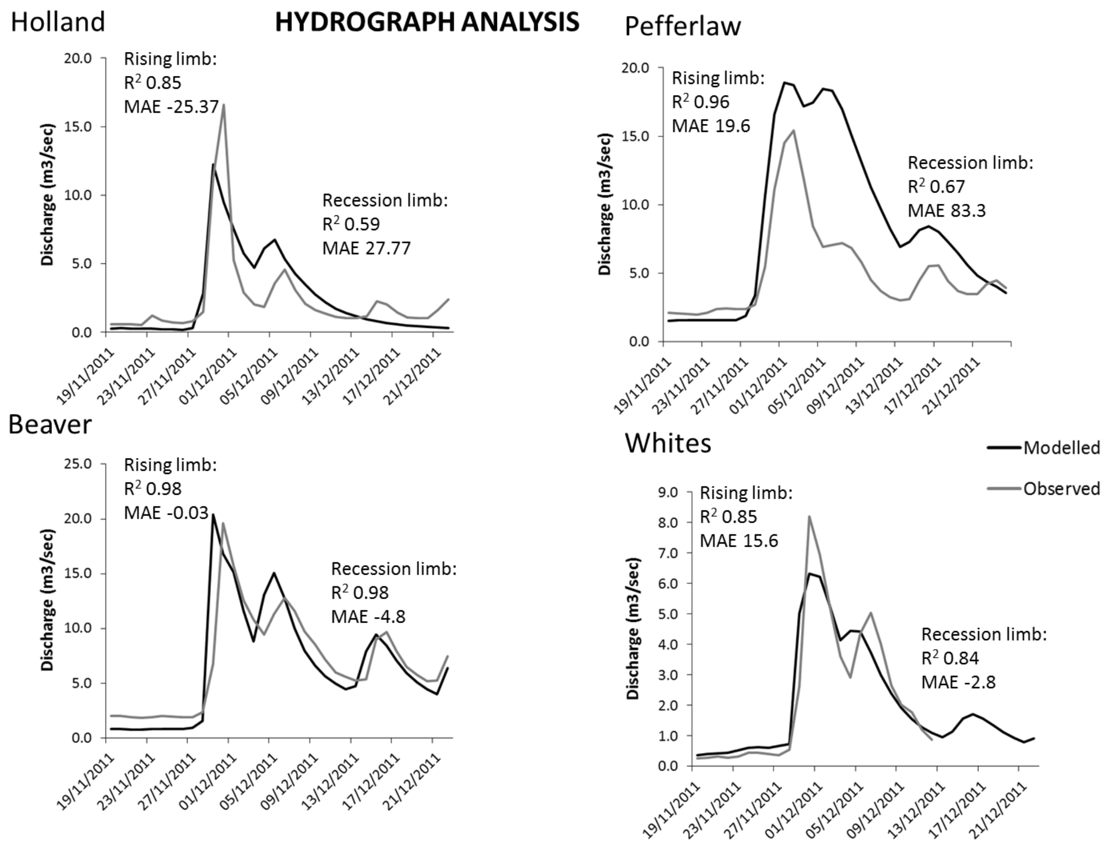

Figure 2: Analysis of INCA model fit to event data at tributary outflow. Rising and recession limb at analysed separately for R2 and MAE to ascertain model representation of catchment responses to precipitation events. All events analysed during four day period of intense precipitation in November 2011. Although these event curves can be used to confirm model representation of reality, it should be noted they should not be used to compare event response times between catchments.

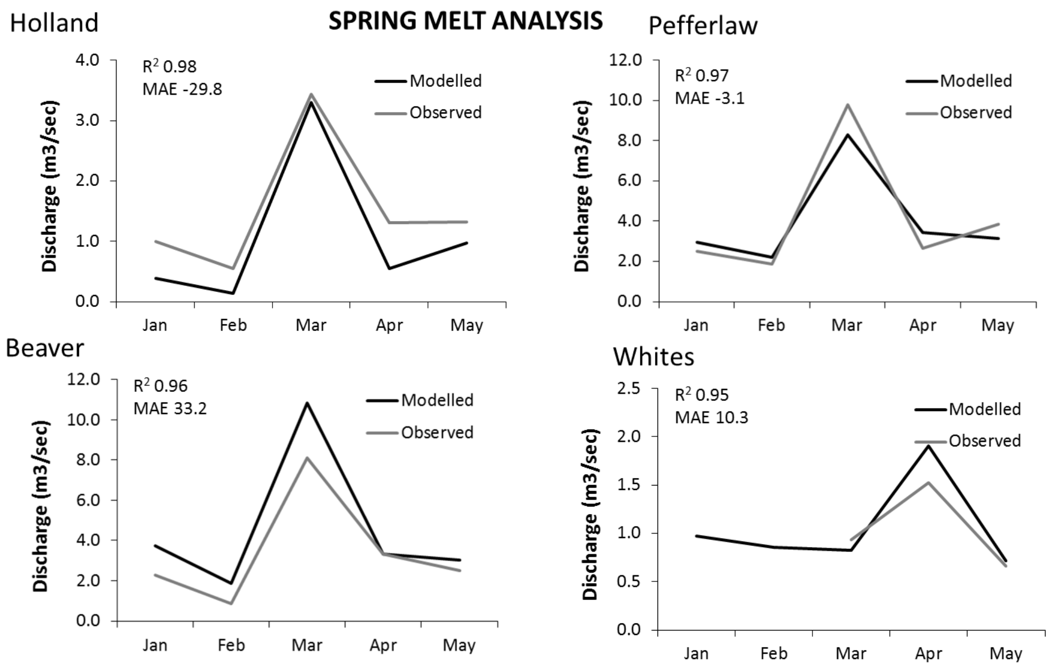

Figure 3: Analysis of model response to observed spring melt. All results presented represent the spring melt of 2010, except in the case of the Whites River, where observations are rarely collected during winter, and an average of 2010 and 2011 results were required to provide sufficient data for analysis.

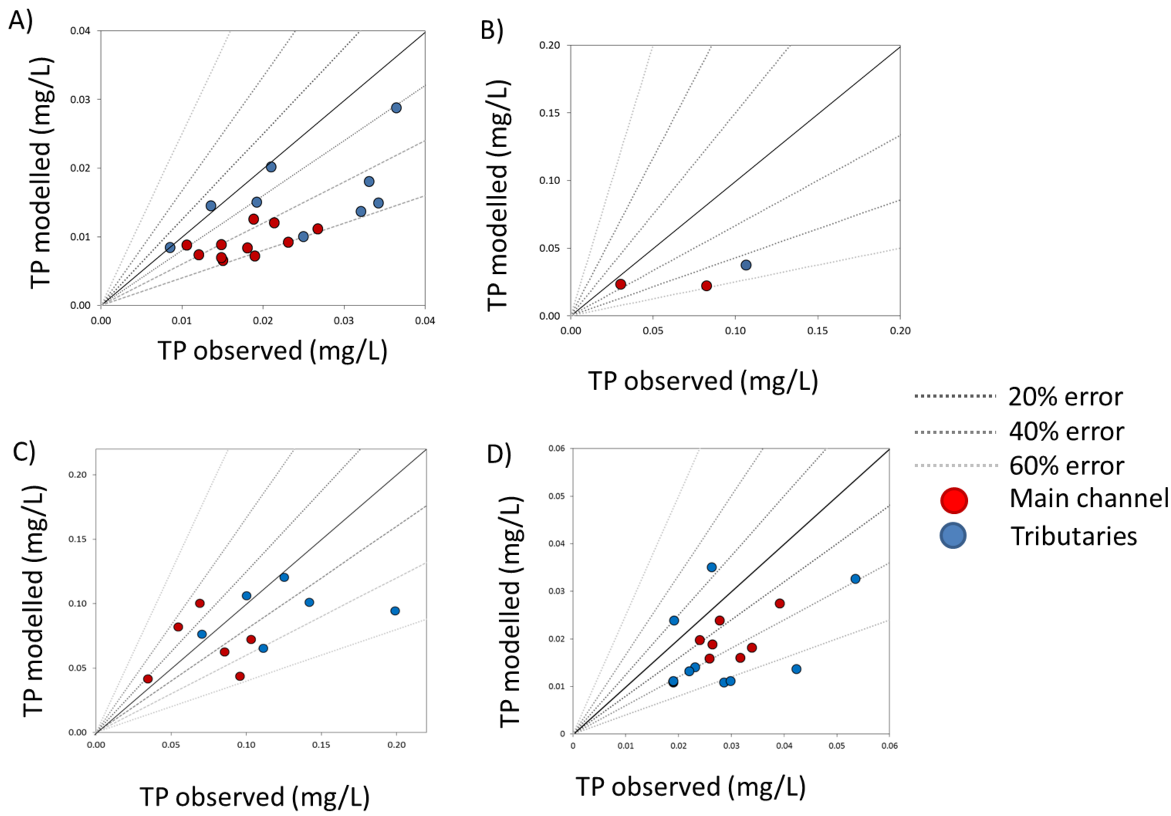

Figure 4: Spatial variability in model accuracy of TP concentrations throughout INCA models calibrated across multiple reaches, illustrating relative model error in A) Holland, B) Pefferlaw, C) Beaver and D) Whites catchments. Data represents average TP concentrations over calibrated period.

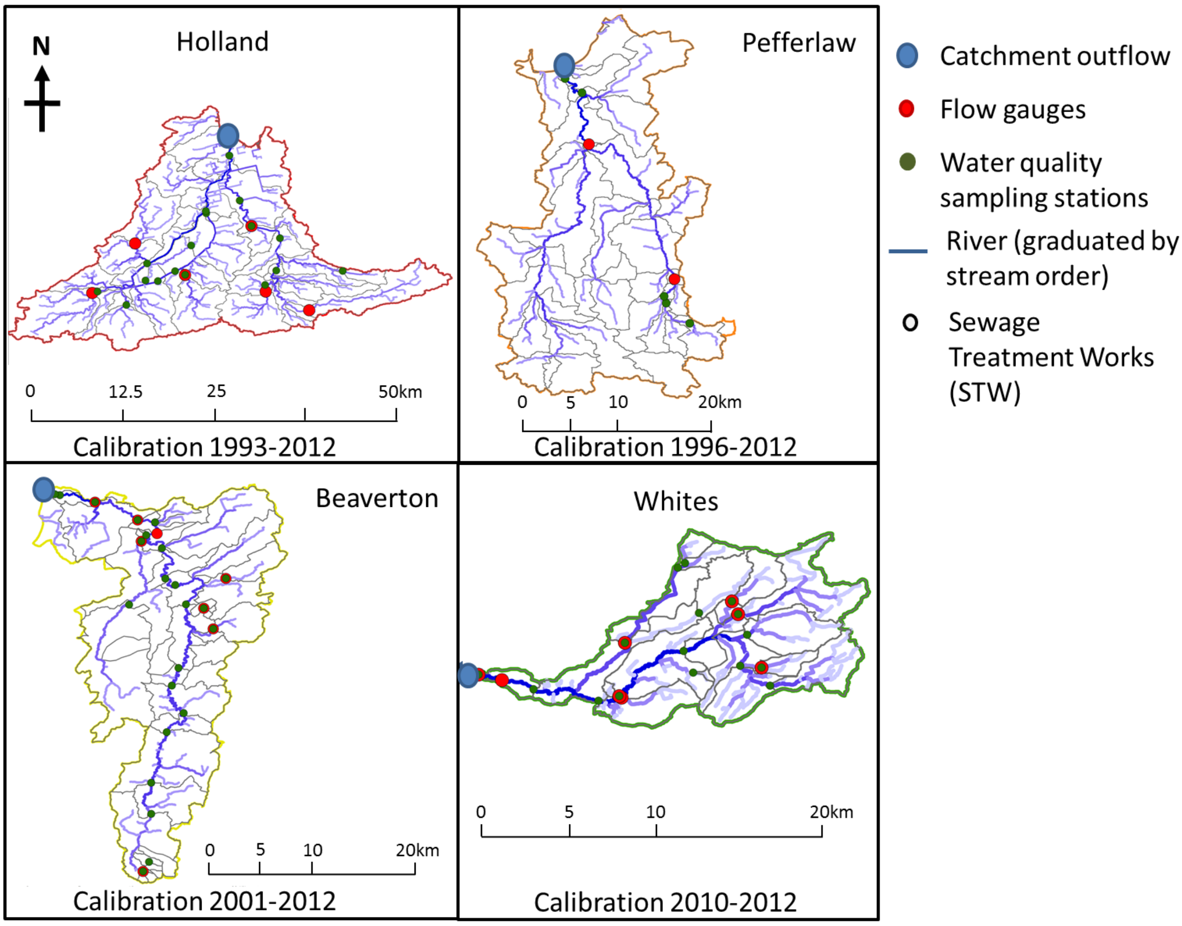

Figure 5: Detailed site schematic of each study area, including location of sewage treatment work (STW) inputs