

Fairchild Creek Subwatershed Characterization Study

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GRAND RIVER CONSERVATION AUTHORITY



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EXECUTIVE SUMMARY

Fairchild Creek is a major tributary of the Grand River (Figure 1). Water quality studies have identified Fairchild Creek subwatershed as providing high contributions of sediments and phosphorus to the Grand River (Holeton, 2013). Excessive phosphorous loading in Lake Erie has led to development of hypoxic zones, and toxic and nuisance algal blooms, threatening drinking water quality and impacting fisheries habitat and resource-based industries. As the largest Canadian tributary to Lake Erie, nutrient loading from the Grand River affects the Eastern basin of the Lake. In 2016 the Canadian and United States governments targeted a 40% reduction of phosphorous loading to Lake Erie’s Central and Western basins. A target for the Eastern basin is forthcoming. Phosphorus reductions to the Eastern basin will need to address point and nonpoint source loading from the Grand River watershed. Improvements in land management and water quality in Fairchild Creek could help to reduce nutrient loading to the southern Grand River and Lake Erie.

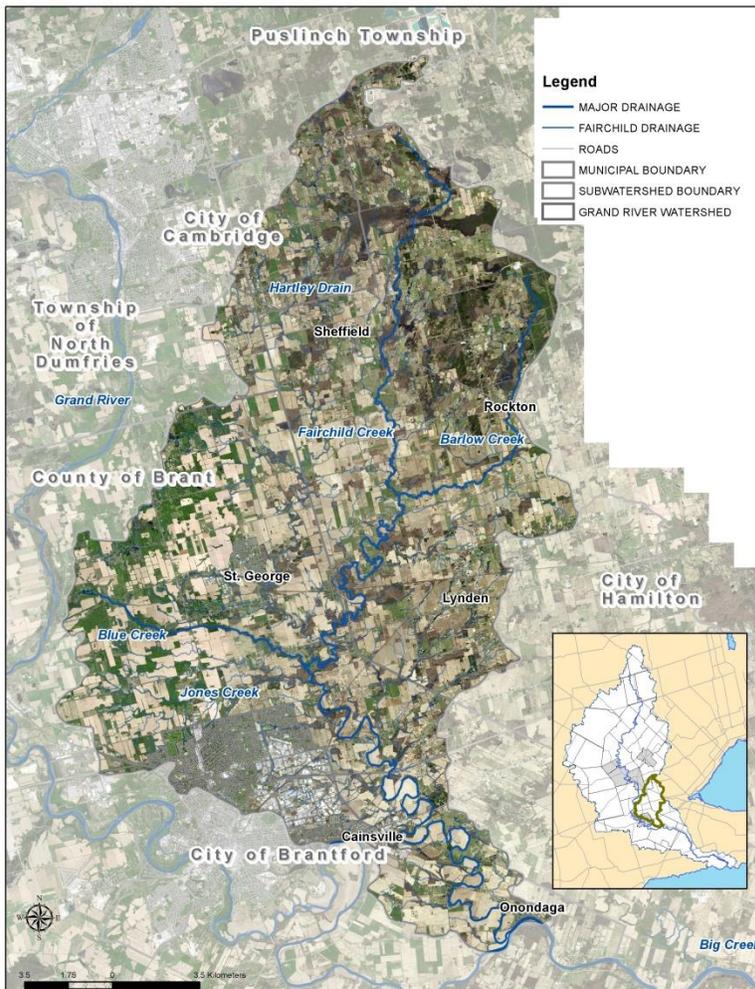


Figure 1: Fairchild Creek subwatershed.

Fairchild Creek has been identified by Grand River Conservation Authority as a priority for subwatershed planning for several years. Most recently, the Grand River Watershed Water Management Plan identified Fairchild Creek as a priority for subwatershed planning to evaluate best value solutions for broad scale water quality improvements (GRCA, 2014). A broader approach to water management planning may provide additional options for future wastewater treatment plant upgrades/expansions. Due to high sediment and phosphorus loading, the subwatershed also is a priority for implementation of Best Management Practices for nonpoint source management (GRCA, 2014).

Key management issues for this subwatershed include reducing nonpoint source pollution (rural and urban), assimilative capacity of the Creek associated with small wastewater treatment plants (St. George), managing existing and future drainage from the City of Brantford, better understanding the hydrology of the Paris Moraine and headwaters wetlands, and protection of cold water brook trout habitat north of Brantford where future development is expected.

In anticipation of nutrient reduction targets for the Eastern basin, and to support a broad range of current and projected resource management needs, a characterization study was initiated for Fairchild Creek. This report draws on existing data and information to document and describe subwatershed features, functions and conditions, and identify gaps in understanding. The study assembled and analyzed available information on groundwater and surface water hydrology, water quality and water use, and aquatic and terrestrial communities and habitat.

This Executive Summary presents a brief description of the characterization findings for the Fairchild Creek subwatershed. It summarizes the key findings for each study component and outlines areas that may require future investigation to fully characterize the subwatershed.

Fairchild Creek is a largely agricultural subwatershed (68% agricultural land cover, 12% urban land cover). Urban centres include the northeast corner of the City of Brantford, the town of St. George, and scattered rural communities. The built-up area associated with Brantford and St. George has grown considerably over the last four decades and further growth is anticipated, including to the north and east of the City, within the Fairchild Creek subwatershed. A related issue is the need to upgrade or expand the small wastewater treatment plants (St. George, Cainsville) and the limited assimilative capacity of Fairchild Creek to accommodate growth.

Natural cover (22% of subwatershed area) is concentrated in large forested wetland complexes in the headwaters of the subwatershed. Outside of the wetland complexes, natural areas are small, fragmented and narrowly sinuous along streams and steep slopes. Woodland and wetland cover are 20% and 9% respectively. These natural areas provide habitat for many provincially significant species, including more than 40 species protected under provincial and federal species at risk legislation.

The hydrology of the subwatershed is strongly influenced by surficial geology and the wetland complexes. In the headwaters, the provincially significant Beverly Swamp Wetland Complex and other wetlands are located on the Flamborough Bedrock Plain, an area of shallow soil and outcropping fractured bedrock. Provincially significant wetlands are located along the Paris-Galt Moraine, running in a band along the western edge of the subwatershed. These complex areas of wetlands, fractured

bedrock, and till provide significant, but poorly understood, hydrologic functions. Groundwater recharge is highest on the Moraine, supporting baseflows in Blue and Jones creeks draining the moraine and the area to the north of the City of Brantford. These cold and cool water streams support Brown trout and the provincially vulnerable American brook lamprey. On-line ponds may contribute to warming of some stretches of the watercourses.

Additional investigation is needed to assess the hydrologic function of natural features within the subwatershed. In particular, the role of the Flamborough Bedrock Plain, Paris-Galt Moraine, and Beverly Swamp in groundwater recharge/discharge and contribution to maintaining baseflows, should be better quantified. More distributed stream flow and temperature monitoring could better characterize the flow regime, baseflow requirements, and groundwater recharge and discharge areas.

The mid-reaches of Fairchild Creek flow through the Haldimand Clay Plain, where the high drainage density, many incised channels, and high rates of surface runoff result in increased potential for erosion. In-stream bank erosion and bed scouring within this region has been identified as a likely source of significant phosphorous and sediment loading. This part of the subwatershed is dominated by agricultural land use activities, but also receives urban drainage from northeast Brantford and the town of St. George. This area supports a warmwater fish community.

Future conditions in Fairchild Creek subwatershed are liable to be driven by development pressure, the resulting impacts on water balance to the north of the City of Brantford, and additional demands placed on the assimilative capacity of the Creek by upgrades or expansions of the existing wastewater treatment facilities. Phosphorus and sediment concentrations remain high in Fairchild Creek. Key non-point sources of sediment and phosphorus are expected to be in-stream and bank erosion, and runoff from agricultural areas; point sources include discharges from the wastewater treatment facilities.

Additional water quality monitoring and assessment is needed to better understand the relative contribution of rural and urban point and nonpoint sources of sediment and phosphorus to Fairchild Creek, to inform selection of management strategies to reduce loading to the creek and the Southern Grand River. Characterization of key areas facing development pressure (e.g., Brantford/Brant Boundary Adjustment Area – Jones and Blue Creeks) is strongly limited by lack of data and outdated information. Monitoring of stream flows, groundwater/surface water interactions, surface water quality and temperature, and biological systems (fish and benthic macroinvertebrates, wetland evaluation) is needed to better understand current conditions and inform future assessments of constraints on development.

Landform, Geology and Groundwater

- The subwatershed extends across **4 physiographic regions**: Paris-Galt Moraine along the western margin, Flamborough Bedrock Plain in the northeast, small strips of the Norfolk Sand Plain in the south and east, and the lower portion of the watershed is dominated by the Haldimand Clay Plain.

- The **Guelph Formation**, a regional bedrock aquifer, underlies the subwatershed. Localized overburden aquifers occur in the Galt Moraine and sand plain deposits. Aquifers in the Paris-Galt Moraines and the bedrock plain region have been mapped as medium to high vulnerability to surface contamination.
- The main thalweg of the **Dundas Buried Bedrock Valley** and a number of secondary valleys underlay the subwatershed.
- Both shallow and deeper **groundwater flow directions** are primarily from the headwaters in the north toward the confluence with the Grand River in the south. Deeper groundwater flows are less influenced by topography and surface water features, with flow directed towards Lake Erie.
- **Groundwater recharge** is estimated to be 135 mm/year, lower than the Grand River watershed average of 176 mm/year. Areas of higher rates of recharge are located along the moraines, which is characterized by sandy tills and hummocky topography, the sand plain areas, and the shallow surface bedrock plain region. The **Beverly Swamp Complex** and the **Sheffield –Rockton Wetland Complex** are important groundwater recharge and storage areas.
- **Groundwater discharge** to streams is predicted to be highest for streams originating near the moraines in the west. Blue Creek and Jones Creek located north of Brantford are important cold water tributaries which are supported by groundwater discharge.

Surface Water Quantity

- Fairchild Creek flows from north to south, draining an area of 401 km². There are two main **watercourse** branches: Fairchild Creek in the west and Barlow Creek in the east. There are several smaller named and un-named tributaries including Jones Creek, Blue Creek, and Hartley Drain.
- **Runoff** from the system is estimated to be approximately 263 mm/year, which is similar to the Grand River watershed average of 266 mm/year, while the **groundwater recharge** rate of 135 mm/year is lower than the Grand River watershed average of 176 mm/year.
- In the upper subwatershed the coarse sand and gravel soils, and hummocky topography (closed depressions), of the Paris-Galt Moraines allow for greater **infiltration** resulting in increased groundwater recharge, and reduced runoff and erosion. The bedrock plain area in the upper subwatershed also contributes to increased infiltration and groundwater movement due to the fractured nature of the bedrock. Beverly Swamp and the Sheffield-Rockton wetland complex also help maintain a reliable low flow component to the system. Downstream on the Haldimand Clay Plain, the system becomes **runoff dominated** with high drainage density and many incised channels, resulting in increased potential for erosion.
- The **mean annual flow** at the Fairchild Creek gauge near Brantford is 3.6 m³/s or 310 mm/year (draining an area of 360 km²). The creek has very little influence on flows in the Grand River.
- Summer **baseflows** are stable, and appear to be maintained by inputs from the Paris-Galt moraines and fractured bedrock zone.
- There are 42 small **privately owned dams** with the large majority of them occurring on tributaries of Fairchild Creek, Barlow Creek, and Blue Creek.

- **Impervious cover** is relatively low with just 12% of the subwatershed with urban land cover. However, more heavily urbanized subcatchments (northeastern Brantford) are experiencing erosion and flow capacity issues associated with urban drainage.
- Approximately 20% of the subwatershed area is **tile drained**, largely on the clay plain.
- There are significant **slope erosion** issues throughout the lower subwatershed on the clay plain.

Surface Water Quality

- Fairchild Creek has been found to contribute the most **suspended sediments** and **phosphorous** to the Grand River per square kilometer than any other major tributary in the watershed.
- Between 2000 and October 2012, **total phosphorus** concentrations in lower Fairchild Creek exceeded the Provincial Water Quality Objective (0.030 mg/L) 98% of the time. Sampling for **total suspended solids** exceeded the 25 mg/L benchmark 83% of the time between 2000 and 2014. Previous studies have determined that total phosphorus concentrations are generally strongly related with suspended solid concentrations in Fairchild Creek. **In-stream bank erosion** and bed scouring, especially within the clay plain region, has been identified as a likely source of significant phosphorus and sediment loading. The relative proportion of loading from the various point and nonpoint sources of nutrients and sediments has not been quantified.
- **Point sources** of nutrients include the St. George wastewater treatment plant and the Cainsville Lagoon.
- Two subcatchments have previously been identified as key **source areas** for sediment: a headwater tributary west of Sheffield which drains the agricultural northwestern region of the subwatershed; and a subcatchment receiving flow from Jones Creek, a tributary originating near Lynden, and urban tributaries draining northwest Brantford.
- Between 2000 and 2014, **total nitrate** concentrations exceeded the long-term water quality guideline for protection of aquatic life (3.0 mg/L) 8.7% of the time, and **chloride** exceeded the guideline (120 mg/L) 3.2% of the time.
- Within Fairchild Creek subwatershed, there have been a total of 175 BMP-related projects implemented under the **Rural Water Quality Program** since 2002. Over half of these projects were tree plantings.

Water Use

- **Agriculture** is the dominant category of water use, accounting for about half of all permitted and actual **water takings** in the Fairchild Creek subwatershed.
- Actual water use was about 8% of permitted use in 2012 and 80% of takings were drawn from groundwater sources. Due to low consumptive water use, the subwatershed has a **low potential for water stress**.
- There are groundwater-based **municipal water systems** in St. George and Lynden. Brantford draws its municipal supplies from the Grand River. Rural residents are on private well systems.

Terrestrial Natural Heritage

- Fairchild Creek subwatershed has about 22% **natural cover**, largely concentrated in provincially significant wetlands in the northern portion of the subwatershed. Most natural areas are small, fragmented and narrowly sinuous along streams and steep slopes.
- Subwatershed **forest cover** is 20%, falling short of Environment Canada's recommended 30% forest cover target for a healthy, sustainable watershed. **Interior forest** accounts for 12% of all woodlands within this subwatershed, or 2.4% of the subwatershed area. Woodlands are concentrated in the middle and northern portions of the subwatershed.
- Subwatershed **wetland cover** is 9%, consistent with the watershed average (9.5%) and within Environment Canada's 6-10% target. About 83% of the wetland area has been evaluated by OMNRF. Ninety-five percent of the wetland area has been designated provincially-significant. Unevaluated wetlands are more prevalent in the southern subwatershed and to the northwest of the City of Brantford. Wetlands within this subwatershed provide key hydrologic functions, serving as headwater areas, and essential storage and recharge/discharge features, supporting baseflows and moderating high flows.
- Part of the **Beverly Swamp Wetland Complex** is located within the subwatershed, one of the largest remaining tracts of intact, lowland swamp forest in Southern Ontario and the headwaters for a number of watercourses within and outside of the Grand River watershed. The Fairchild Creek Headwaters Wetland Complex and Beverly Swamp together, connected via a surface watercourse, make up one of the largest, contiguous natural areas in the Grand River watershed.
- One provincially significant life science Areas of Natural and Scientific Interest (ANSI) (Beverly Swamp) and one regionally significant life science ANSI have been identified and mapped by the province.
- 99 wildlife species recorded in the study area are ranked by the Natural Heritage Information Centre as being **provincially significant**; 46 of these species are listed as species at risk at the provincial and/or federal level. Birds represent about half of all known species at risk within the study area.

Aquatic Natural Heritage

- Forty-seven **fish species** have been recorded within Fairchild Creek subwatershed and nearby sections of the Grand River. A majority (70%) of the species prefer cool or coldwater habitat.
- The majority of the classified watercourses support **warm water fisheries** with top predators being restricted to deeper, permanently flowing sections of Barlow Creek and Big Creek in the east.
- Blue Creek, Jones Creek, the Hartley Drain, and a few of the smaller municipal drains within or near the Town of St. George are classified as **cold water habitat**. **Salmonids** are thought to be limited to Blue Creek and Jones Creek only. Blue Creek supports **American brook lamprey** (rare in Ontario).

- Five **provincially significant fish species** have been recorded within the Fairchild Creek system and the main stem of the Grand River: American brook lamprey (rare in Ontario), Black redbhorse (threatened in Ontario), Greater redbhorse (rare in Ontario), Brindled madtom (imperiled in Ontario) and Eastern sand darter (threatened in Ontario and Canada). Two federally endangered mussel species have been recorded: Rainbow mussel and Round pigtoe.