

## **Field Monitoring Program, Bighill Creek Watershed, January, 2022**

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### **Water Quality Monitoring Activities, January 29-30, 2022**

#### **Introduction**

On Jan 29 and 30, 2022, supporters and members of the Bighill Creek Preservation Society (BCPS) carried out a limited water quality sampling program. Four sites were sampled as per described in Table 1 (also see photos, 1-18). In short, we sampled, from upstream (u/s) to downstream (d/s): Big Hill Springs (BH Springs); two sites in Bighill Creek (Bh Creek); and one site in Millennium Creek. Millennium Creek discharges into Bighill Creek just upstream of the Bighill Creek confluence with the Bow River.

The springs in Big Hill Springs Provincial Park have been rated as one of the top 4 in all of Canada, when compared to 62 mineral springs across Canada, as reported in a study funded by Parks Canada (Houseknecht 1984).

As well, Bighill Creek is recognized by the Government of Alberta (1997, 2001) as an “Environmentally Significant Area of Alberta”.

Both the springs (nationally significant) and the creek (provincially significant) are therefore worthy of the attention, care and protection, that is the focus of the BCPS, a nonprofit society, and the work of the Society is therefore well-grounded, in science-based field monitoring initiatives. Field data, empirical data provides the background upon which wise sustainable environmental management decisions can be made by those in the province of Alberta who regulate such decisions.

#### **Methods**

Field methods followed the methods and approaches (guiding principles) of Alberta Environment (2006a, 2006b). Two YSI multiparameter meters were used to take measurements of pH, Electrical Conductivity (EC), Temperature (T), and Dissolved Oxygen (DO). Field conditions at the time (air temperature, light, substrate type and cover, % ice cover, water colour and odour, if any) were also recorded. In some locations the stream was ice-free and so it was straightforward to extend the probes into the stream. At other sites, breaking through the ice was first required, to create a hole through which to extend the two probes.

#### **Results and Discussion**

All data are reported in Table 1. The lowest EC (electrical conductivity) result was recorded in Big Hill Springs, and EC increased further downstream in Bighill Creek. EC is a measure of the amount of dissolved salts found at a given site: the more salts, a higher EC. The low EC recorded in BH Springs is likely a reflection on how clean and pure the groundwater feeding the spring is - and therefore the unique need to protect this water supply.

Both BH Springs and Millennium Creek recorded much higher temperatures (4.2 - 4.6 deg C) than the two sites sampled in Bighill Creek, in fact there was zero ice cover in the former. The

two Bighill Creek sites were 100% ice covered, with temperatures of 0.1 deg C. Based on the water temperature data, and % ice cover, Millennium Creek is also, in the near vicinity of the creek, spring fed.

Specific to Millennium Creek, the Creek was sampled on two days, the reason being one of the two YSI field meters malfunctioned on day 1, January 29<sup>th</sup>. DO (dissolved oxygen) values on day 1, Jan 29<sup>th</sup>, were 10.84 mg/L and on the 30<sup>th</sup> were 12.59 mg/L. DO values were higher on the 30<sup>th</sup>, since we sampled at dusk on the 29<sup>th</sup> (note in the comments under Table 1, conditions at the time were "overcast/sunset"). On Jan 30<sup>th</sup>, sampling occurred at mid-afternoon and with a sunny sky. In addition in the comments under Table 1, note the description of the substrate: "algae and macrophyte covered". Photosynthesize by the green-chlorophyll-containing algae, and macrophytes (aquatic weeds) during the day, on Day 2, was more active with the stronger sunshine present, and so more oxygen produced, and the higher DO values on Day 2.

The EC in Millennium Creek was by far the highest of all the four sites sampled. The reason is unknown and will require further investigation. The creek originates in, or nearby an upstream subdivision, and perhaps there is some infiltration of dissolved salts from urban storm sewers in the area. Further investigation is warranted before any further speculation.

All data collected is of good value and will help, along with other, existing data, namely in (Foule 2018, 2020); City of Calgary (multiple years); Alberta Environment and Parks (multiple years); and U of C Geosciences (flow at the mouth, open water months since 2011) provide a description of baseline water quality (and flows) in the Bighill Creek watershed, and can be used to identify, the impacts of any major anthropogenic disturbances (e.g., industrial activities) that may occur in the watershed.

### **Additional water quality monitoring**

Monitoring continues in 2022 in the Bighill Creek watershed, in fact, is ongoing from 2021. The Society (BCPS), with Trout Unlimited Canada TUC) are recording instream temperature every 30 minutes, 24/7, at a number of sites in the watershed (for e.g., 11 sites in 2020 (TUC 2020). Data loggers (by Hobo) are currently (Feb 2022) installed at 6-10 sites in BH Springs and Bighill Creek. These automated recordings have been occurring for months now. Should any anthropogenic activity impact the temperature of the springs and creek, in particular in the BH Springs, the current baseline data on water temperature, based on discrete measurements over the years, and including Jan 29-30, 2022, but even more so, the continuous data at multiple sites will identify if the activity is impacting the spring and creek instream temperatures. Water temperatures in the creek (trout bearing) are low due to the consistent cold water coming from Big Hill Springs, and so the springs (source of cold water) are the critical component in providing for trout habitat in Bighill Creek (rainbow, brook and brown trout identified in the creek) (see TUC, 2018). The fish inventory results identify that the three salmonid species (trout) are part of the currently healthy ecosystem in the Bighill Creek watershed. Also, supporting the description of a healthy, diverse aquatic ecosystem in the Bighill Creek watershed, - see the site specific work as reported in Tobin (2020); University of Guelph (2019), and Cows and Fish (2018).

Trout cannot survive in warm water since warm water physically holds less DO compared to cold water. As well, warm water conditions overheat trout, as they have a very high metabolism rate that cannot be controlled in warm water conditions. Trout are cold water fish. Suckers, chub, and stickleback minnows are more tolerant. Trout will die off at higher water temperatures, which would be a significant loss to the biodiversity of the Creek.

### **Comparison of data collected to the AEP Guidelines for the Protection of Aquatic Life**

**(PAL):** The data of Jan 29, 30, 2022 were compared to the AEP (Alberta Environment and Parks) PAL guidelines GOA (2018). All values for pH, EC, DO and T were well below any acute and chronic lethality values. Water quality is excellent.

**Recommendations:** Water quality monitoring of BH Springs and Bh Creek should continue in 2022, both a) the discrete sampling (on a given day and time) at various sites; and b) the continuous, automated sampling as per for instream water temperatures. Sampling should occur monthly, bimonthly, or by season, - summer, winter, fall, spring. Additional sampling should also include the, at a minimum, various dissolved salts, nutrients (nitrogen and phosphorous), metals and fecal coliform bacteria / E.coli.

The Bighill Creek Preservation Society has been very proactive in conducting field studies in water quality, sediment, DNA, fish inventory, benthic invertebrate diversity, and riparian health. Their ongoing field programs will continue to allow the Society to be well placed to detect changes in environmental conditions in Big Hill Springs and Bighill Creek.

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## TABLES

**Table 1. Water Quality Monitoring Results, Bighill Creek Watershed, January 29, 30, 2022**

Location	Date, Time	Temperature (°C)	Electrical Conductivity <sup>5</sup> (µS/cm)	pH	Dissolved Oxygen (mg/L)
Big Hill Spring in Big Hill Springs Prov. Park <sup>1</sup>	Jan. 29, 2022 15.45hrs	4.4	571.4	7.94	10.92
Bighill Creek at bridge by St Francis Retreat. <sup>2</sup>	Jan. 29, 2022 16.45 hrs	0.1	601.7	8.05	12.00
Bighill Creek near the confluence, Bow R. <sup>3</sup>	Jan. 29, 2022 17.15 hrs	0.1	667.4	8.12	12.17
Millennium Creek near confl. BH Creek <sup>4</sup>	Jan. 29, 2022 17.30hrs	4.2	Nd <sup>6</sup>	nd	10.84
Millennium Creek near confl. BH Creek <sup>4</sup>	Jan. 30, 2022 14.45hrs <sup>7</sup>	4.6	849.0	8.15	12.59

**Footnotes:**

<sup>1</sup> Big Hill Spring in Big Hill Spring Provincial Park, at the second foot bridge, upstream of the public road into the Park.

<sup>2</sup> Bighill Creek at bridge by St Francis Retreat.

<sup>3</sup> Bighill Creek near confluence with the Bow River (but upstream of confluence with Millennium Creek).

<sup>4</sup> Millennium Creek near confluence with Bighill Creek.

<sup>5</sup>Electrical conductivity is recorded as “Specific Conductance”; a measure of the dissolved salts in the water.

<sup>6</sup> nd: no data.

<sup>7</sup>All times recorded at MST, Mountain Standard Time.

**Site descriptions, day of sampling:**

- Big Hill Spring, Jan. 29, 2022: air temp 4.5°C; overcast; water -clear, colourless and odourless; substrate, cobble/gravel, macrophyte covered; ice cover, 0%.
- Jan. 29, Bighill Creek at bridge near St Francis Retreat, Jan. 29, 2022: air temp 4.2°C; overcast; water - clear, colourless and odourless; substrate, boulder-cobble; ice cover, 100%
- Jan. 29, Bighill Creek near mouth, Jan. 29, 2022: air temp 3.5°C; overcast; water - clear, colourless and odourless; substrate, boulder-cobble; ice cover, 100%
- Jan. 29, Millennium Creek near confluence with Bighill Creek, Jan. 29, 2022: air temp 3°C; overcast/sunset; water – clear, colourless, odourless; substrate, algal and macrophyte covered; ice cover, 0%.
- Jan. 30, Millennium Creek near confluence with Bighill Creek, Jan. 30, 2022: air temp 6.5°C; sunny; water – clear, colourless, odourless; substrate - algal and macrophyte covered; ice cover, 0%.

**Field Instruments:** YSI ProODO, Optical Dissolved Oxygen meter; YSI Professional Plus (Pro Plus) Multiparameter meter.

**Field technicians:** Dr. K Stevenson, R. Landwehr, W. Koning. **Data summary:** F. Landwehr.

**Final note:** All results are the property of the Bighill Springs Preservation Society, <https://bighillcreek.ca/>.

## PHOTOS



Photo 1. Big Hill Springs monitoring site, on pedestrian bridge, Jan 29, 2022



Photo 2. Bighill Creek, u/s of vehicle bridge by St Francis Retreat, Jan 29, 2022, preparing an open water hole for water quality sampling.



Photo 3. Bighill Creek, u/s of vehicle bridge by St Francis Retreat, Jan 29, 2022, inserting probes into the opened hole in the ice.



Photo 4. Bighill Creek, at bridge by St Francis Retreat, Jan 29, 2022, showing the two probes in the creek in running water under the ice.



Photo 5. Bighill Creek, at bridge by St Francis Retreat, Jan 29, 2022, looking downstream to the foot bridge over the creek.



Photo 6. Bighill Creek, at bridge by St Francis Retreat, Jan 29, 2022, looking downstream from the footbridge.





Photo 7. Bighill Creek near the confluence with the Bow River, Jan 29, 2022, chopping hole in the ice.



Photo 8. Bighill Creek near the confluence with the Bow River, Jan 29, 2022, preparing probe for taking field measurements.



Photo 9. Bighill Creek near the confluence with the Bow River, Jan 29, 2022, lowering probe into open water.



Photo 10. Millennium Creek upstream of its confluence with Bighill Creek, Jan 29, 2022, taking field measurements.



Photo 11. Millennium Creek upstream of its confluence with Bighill Creek, Jan 29, 2022, looking through the railing of the pedestrian bridge, upstream to the nearby subdivision.



Photo 12. Millennium Creek upstream of its confluence with Bighill Creek, Jan 29, 2022, looking upstream towards a nearby subdivision.



Photo 13. Millennium Creek upstream of its confluence with Bighill Creek, Jan 29, 2022, looking downstream towards Bighill Creek and the nearby Bow River.



Photo 14. Bighill Creek very near the confluence with the Bow River, Jan 29, 2022, along the Town recreational/pedestrian pathway, looking south from near the “Bighill Cr, upstream of the confluence” site.



Photo 15. Millennium Creek upstream of its confluence with Bighill Creek, Jan 30, 2022, taking field measurements, day 2.



Photo 16. Millennium Creek upstream of its confluence with Bighill Creek, Jan 30, 2022, looking at probe resting on the streambed.



Photo 17. Millennium Creek upstream of its confluence with Bighill Creek, Jan 30, 2022, with probe in streambed.



Photo 18. Bighill Creek near the confluence with the Bow River, Jan 30, 2022, looking downstream towards the confluence with the Bow River.

**END**

***Authors: W. Koning, K. Stevenson, February 7, 2022.***