P1.36

Investigating The Chemical Properties Of Milky Stream In The Bob Marshall Wilderness Area In Montana

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Introduction

During the summer of 2004 eleven high school students from Central Pennsylvania participated in a holistic study of the Upper Dearborn River and select tributaries in Central Montana. A preliminary survey of the area indicated that most of the streams displayed similar properties with one exception, Milky Stream. Milky Stream exhibited characteristics of turbidity, discoloration, and significant sediment buildup on the bottom of the stream channel, as shown in figure 1. A study was designed to collect data and ascertain the unique chemical characteristics of Milky Stream as compared to the Dearborn River and other tributaries.

Figure 1) Confluence of Milky Stream into the Dearborn River

Study Area

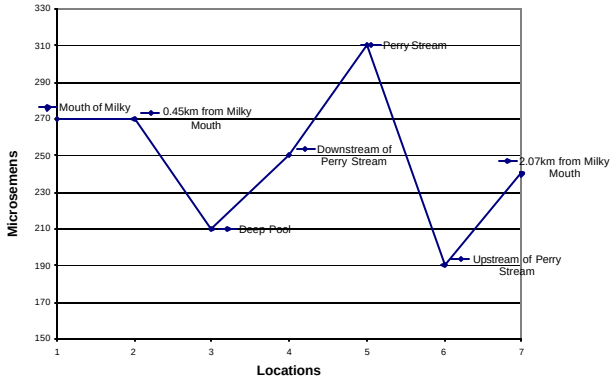
Five study sites along Milky Stream were identified according to their distance from the mouth of the stream and their relevant topography. Two sites on the Dearborn were chosen, one upstream from the confluence of Milky Stream and the Dearborn, and one downstream. The latter was to determine the influence of this anomalous stream's chemical effect on the Dearborn River. In addition, chemical studies were compiled on the other tributaries to determine if any of these streams had a significant influence on the Dearborn River. Tests and instruments to were measure rate of stream flow and stream chemistry employed on all streams. The stream chemistry tests were conducted to determine the vitality of the tributaries and their influence on the Dearborn River.

The investigated chemical parameters are important in determining whether or not the streams and river are capable of supporting life, and in assessing overall stream vitality. We also assessed stream vitality through a study of the macro invertebrates in the Dearborn River and Milky Stream.

Tests

The tests used to discover the chemical properties of the stream were as follows; Dissolved Oxygen (DO), pH, Total Alkalinity, Conductivity, Ammonia, Carbonate (CO_3^{-2}) Alkalinity, Phosphate (PO_4^{-3}) Alkalinity, Nitrates and Free Chlorine. In order to determine the physical properties of the streams, stream discharge properties were completed using a Gurley Meter. Ammonia, Carbonate Alkalinity, Phosphate Alkalinity, Nitrates and Free Chlorine were not found in any quantity, or so low that our instruments could not measure them, in either the Dearborn River or its tributaries and therefore no further tests were conducted on these elements.

Chart 1: Conductivity at Select Location along Milky Stream



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Data

The data for both the streams, specifically Milky Stream were collected and compiled into charts and graphs. Select portions of this data are presented below in order to illustrate the components of the analysis.

Table 1: Data Collected at select locations along Milky Stream and Dearborn River

	pH	Temperature C	Conductivity m	DO ppm	T. Alkalinity ppm
1.45 km from milky mouth after Perry	-	10.8	250	14	185
1.45 km from milky mouth Perry Stream	7.63	6.3	310	15	217
12.5 m downstream from milky mouth	8.57	16.3	250	-	-
Dearborn 3.7 m upstream from mouth Milky	8.28	12.9	210	13	160

Chart 2: Total Alkalinity at select locations along Milky Stream

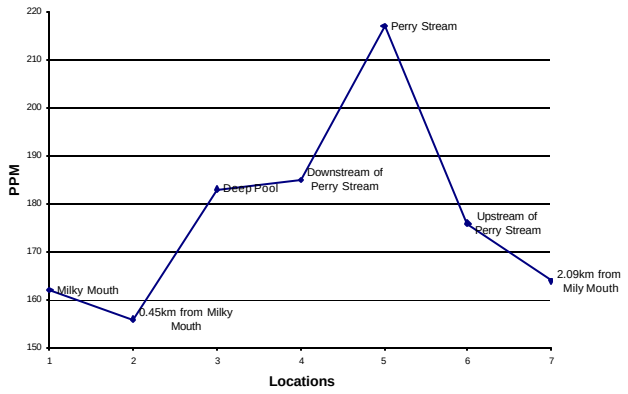
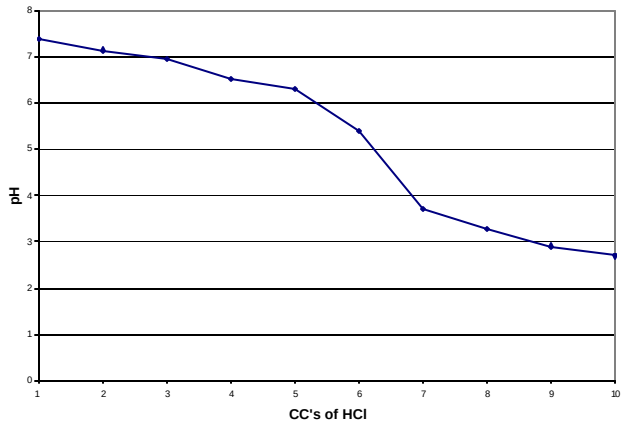


Chart 3: Buffering Capacity of Milky Stream



Analysis

It was hypothesized that the streams and rivers flowing into the Dearborn would have good vitality. In order to determine the general health of Milky Stream, the following tests were looked at and compared to other hearty streams in the area; DO, Alkalinity, Conductivity, Buffering Capacity, and pH. Upon investigation of these tests it was discovered that Milky Stream was in good health.

Figure 2: Colluvium washout from exposed Valley Walls into Milky Stream

The Study of the Total Alkalinity and of the buffer capacity conducted on Milky Stream found that an unnamed stream was one of the sources of Milky Streams buffering capacity, high alkalinity, and high conductivity.

These results are not surprising due to the composition of the dolostone rock face that the unnamed stream flows down. It is mainly comprised of Mg and $CaCO_3$, the components to the buffering system in Milky Stream, however the results as to the exact components of the rocks are pending chemical analysis. Therefore the general spike in the conductivity and total alkalinity was anticipated, and led to the buffering capacity of Milky Stream. The conductivity measurements discovered a large spike in dissolved ions entering Milky Stream by means of the unnamed stream. The stream gets its water from small underground springs, which are extremely high in conductivity, measuring as high as 310 microsemens. These streams come out of a dolostone rock outcrop that is mainly composed of Mg and $CaCO_3$. A second source of these components is from the Colluvial wash from exposed valley walls,

composed of the same dolostone that the springs came from. These two elements are the main contributor to Milky Stream's milky characteristic, turbidity, alkalinity, conductivity, and buffering system. Samples of water from Milky Stream were titrated using 0.1M HCl, to discover the buffering capacity of Milky Stream. The stream can accept $5x10^{-4}$ mol H^+ ions. The acid rain content of the Scapegoat Wilderness is not sufficient enough to overwhelm the buffer system found in Milky Stream.

Once tests are run to determine the exact chemical makeup of this rock outcrop a more accurate model can be made. It should also be noted that before this area, which is 1.45 km upstream from the confluence of Milky Stream and the Dearborn, none of this anomalous characteristics were observed.

Chart 4: Ca+2 Hardness (tested outside of field)

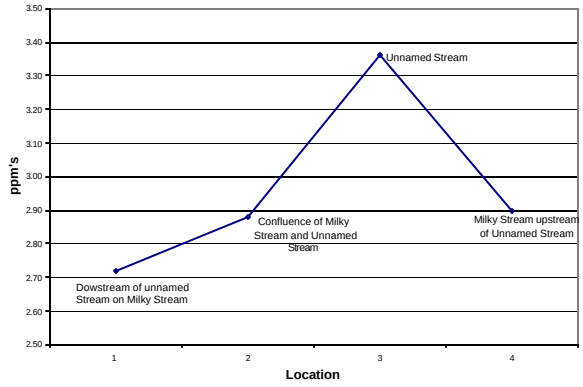
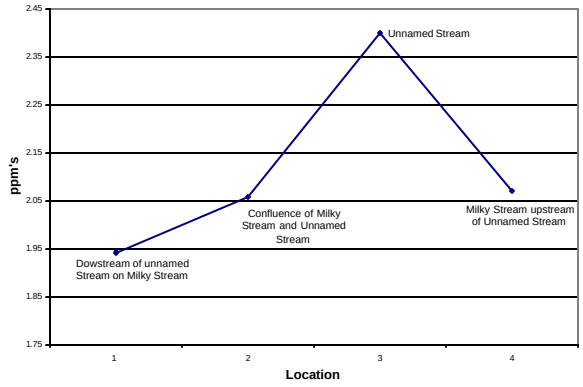


Chart 5: Mg+2 Hardness (tested outside of field)



The hardness tests in charts 4 and 5 were conducted outside of the field in a local laboratory in Bozeman. The water samples were not stabilized for transportation from field to lab. However since none of the samples were stabilized it can be said that the decease in ions in the water was similar in all samples and therefore only affected the accuracy of our data, not the precision. From this data it can be concluded that the unnamed stream brings with it a large excess of Mg^{+2} and Ca^{+2} ions into the Milky, supporting the findings of the Conductivity and Alkalinity, and supporting the theory that the Conductivity, Alkalinity, and Buffering System come partially from that same unnamed stream.

A general analysis of macro invertebrates in Milky Stream was conducted by attempting to collect and identify species. However the stream yielded almost no specimens. The specimens we did find were as follows, one midge fly, 3 stoneflies, and about 5 water striders. This was very surprising because it was hypothesis that Milky Stream would be in good enough health to support life. However upon further analysis of the stream it could be determined that no larger macro invertebrates are capable of living in the stream due to possible decreasing stream flow in later months, however this would have to investigated at anther time. Another possible explanation as to the lack of macro invertebrates is the percent saturation of Oxygen. The average percent saturation of Oxygen in Milky Stream was 129%. According to Hach (1991) the excellent level for fish is 80-124% saturation, this level is just above that, and therefore this could account for the lack of fish. Corrections for altitude are being investigated and will be reported. It should also be noted that the Dearborn River was teaming with life, from larvae, to stoneflies, to fish eggs, and fish.

Another addition to the conclusion that both the Dearborn, and all other streams in the area were in general good health was due to the dearth of Nitrates, Phosphates, Ammonia, and Chlorine. Since these chemicals were not in any of the streams, or in such low quantities that our instruments were not capable of reading them, then it can be concluded that all streams in the area were free of pollutants and thereby healthy.

As was expected the addition of Milky Stream's water to the Dearborn gave a momentary spike in conductivity, turbidity, and alkalinity downstream of the confluence. However Milky Stream in no way adversely affected the chemical properties of the Dearborn River due to simple water ratios. The Dearborn River is much larger in size than Milky Stream. Within Milky Stream's plume large amounts of turbidity, conductivity, and alkalinity were observed, however once the two bodies of water caballed, then the conductivity, alkalinity, and

turbidity approached that of the Dearborn River before the confluence of Milky Stream.

Limitations

Some of the tests such as DO, and Total Alkalinity required a small amount of subjectivity in that the solutions had to be titrated to a color, and therefore these tests are subjected to human error.

For the hardness tests conducted outside of the field, the samples were not stabilized, thereby allowing ions to escape. However this did not affect the precision of the samples because all samples lost equal amounts in transportation.

Figure 3: Flood Plain of Milky Stream at confluence of Milky Stream and Dearborn River

Conclusion

It was originally hypothesized that Milky Stream's unique characteristic started with the origin of the stream. However upon further investigation it was discovered that the turbidity increased at one specific point, that point being a rock outcrop 1.45 km from the confluence of Milky Stream and the Dearborn River. At this location a stream fed into the Milky, and this stream was composed of underground springs coming from that particular rock outcrop. Another contributor to this anomalous stream is the washout of the valley sides into milky stream, which were also composed of this unique rock outcrop. This accumulation of sediment from these two locations led to the milky characteristics discovered in the stream, along with its high conductivity levels, alkalinity levels, and its buffering capacity.

References

Hach Company Surface Water Test Kit catalog Number 25598-00 (1991)

Mitchell, Mark K. Stapp, William B. 1993: Field Manual for Water Quality Monitoring 7th Edition

Water on the Web http://www.waterontheweb.org/under/waterquality/oxygen.html

Rosgen, Dave. 1996 Applied River Morphology Tagosa Springs CO.

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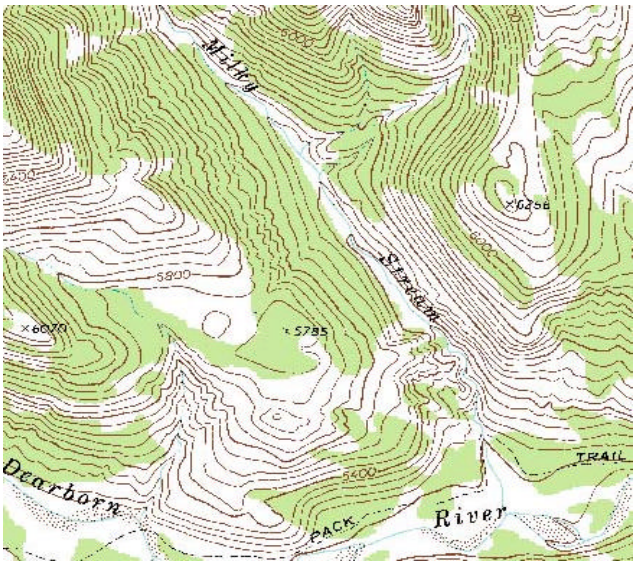

Figure 4: Topographic map depicting the region of the study.