MERG Report 1999-1- Winter Low Flow Stream Measurements Using the Salt Slug Injection Method

Laberge Environmental Services

Non-technical summary

WHY MEASURE STREAM FLOW IN THE WINTER?

It's late winter. Everything looks frozen in the Yukon, but there is life under the ice and snow of creeks and rivers. This time of year is critical for many species, and especially for aquatic life. Fish and their food may be waiting out the winter in streams where there are deep pools or undercut banks with enough water and oxygen to survive. The weather above, although it may be starting to warm up, is still going down to minus 30 for lows. The environment under the ice and snow is much warmer, with water temperatures just above zero and ground water at about four degrees. The annual water cycle is at its lowest point. Ground water is still flowing to streams but this part of the water cycle, called base flow, is nearing its lowest volume of the year.

Meanwhile, a mining company is busy above processing ore or planning a mine. The environmental people who work for the mining companies and for the government are monitoring the streams above and below the mine area to see if there are any harmful effects on the sensitive streams, or they are trying to establish the basic characteristics, called baseline conditions, of the area. These people want to know what the rate of flow is in the stream, called the discharge.

HOW IS IT USUALLY DONE, AND HOW IS THIS METHOD DIFFERENT?

Normally, a velocity meter is used to measure the speed of the current, and the cross sectional area is measured. These are multiplied to calculate the discharge. In late winter this method doesn't work very well because of cold, ice, and very small flows.

This project was done to test a method of measuring discharge without having to use a current meter. The method is called the Salt Slug Injection Method of Stream Flow Measurement, or the Salt Dilution Method. It is based on the conservation of mass, that is to say that the total mass of a substance is not affected by a chemical change in that substance. The substance is salt, or sodium chloride (NaCl), exactly the same as the kind on the table. In this method, salt is used as a tracer. When added to a stream in a carefully weighed amount, it increases the concentration of sodium on the stream for a brief time and distance. The concentration of sodium is directly proportional to the electrical conductance (conductivity) of the water. So conductivity is measured before and during the time when a wave of salt dissolved in the water passes by a point. Then the discharge is calculated using an arithmetic formula that converts the rise in conductivity to rate of flow in cubic meters per second.

Using salt as a tracer to measure stream flow has been tested in other places in open water, but it has not been tested in low flow conditions in the Yukon as a way to measure discharge in mine monitoring areas. The objective of this project was to see if this method is practical and accurate for use in local conditions in late winter.

WHAT WERE THE RESULTS?

The discharge calculated by the salt dilution method was compared to other methods and seemed to give very similar results. A computerized method was also tried, where a laptop computer is connected to the conductivity meter to do all the

arithmetic automatically, but we found that it was not very easy to keep all the equipment from freezing up, and the software was clunky. It was better to keep equipment to a minimum and record the increase in conductivity by hand. Using a spreadsheet helps to do the calculations back in the office. The addition of salty water to a stream was looked at to see if there was any harm done to the aquatic life in the stream by the method itself, and there was no harm that we could measure.

The report concluded that the Salt Dilution method is a good alternative to find out the discharge in small streams under ice.