INTERPRETATION OF A WATER ANALYSIS

Chemical analyses of water are becoming more common as Municipalities, Regional Districts and other approving agencies, require water analyses as part of information necessary for approval of land subdivisions. The analyses vary in completeness; some list only a few of the main constituents while others are very comprehensive. At a site where contamination is suspected or is possible, the analyses may include certain unusual contaminants associated with activity on the site.

The amounts of chemical constituents in natural fresh water are small to extremely small and the units used to report on the amounts are milligrams per litre (mg/l) and in some analyses, parts per million (ppm); for water these units are equivalent. A milligram is one thousandth of a gram; a litre contains 1000grams. Thus, there are one million milligrams in a litre; one milligram per litre is the same as one part in a million. For certain contaminants or toxic constituents, such as arsenic, a smaller unit is used- a microgram per litre (ug/l) or part per billion (ppb); this is one one-thousandth of a milligram per litre. Water analyses may also contain numerical measurements of certain physical properties of water such as hardness, turbidity, colour, conductivity, and pH. Contaminants of groundwater with nutrients is not permanent and, once the source is removed, the contamination soon disappears.

For water user, the question is: What does this analysis mean with respect to the health of the individuals using the water? Most of the items that are contained in the analyses of water for domestic use are listed following, with a brief explanation of their significance. Consideration is first given to the main constituents which appear even on partial analyses.

GIARDIA: A real problem, which is becoming better known in B.C. is infection of some surface water sources with the parasitic organism Giardia lamblia. This causes an illness called Giardiasis, often known as "Beaver Fever". The Giardia parasite infects many, if not most

species of wild and domestic animals and the infection can be passed on to humans by water. The usual chlorination procedure is not effective against Giardia, but sand filtration is used to remove the organisms from water.

CONDUCTIVITY, which is a measure of the electrical conductivity of water, is usually expressed as either *u*mhos/cm or as *u*siemens (pronounced micro moes and microsiemens which are equivalent). The conductivity of water varies according to the amount of dissolved mineralization in the water. Conductivity can range from less than 50 to several thousand *u*siemens. A value over 1000 indicates an high degree of mineralization but waters with conductivity over 2000 *u*siemens are used in some places. Average well water in B.C. has a conductivity in the range 100 to 600 *u*siemens.

TOTAL DISSOLVED SOLIDS – expressed as milligrams per litre of parts per million – is a measure of the total mineralization in the water. It is a more precise measure of mineralization than conductivity and it varies from less than 50 to about 30,000 for sea water. Most well waters in B.C., are in the range 100 to 600 mg/l.

pH:- is the measurement of the hydrogen ion concentration in the water. A pH between 0 and 7 is acidic (the lower number the more acidic the water), a pH of 7 is neutral, and a pH of 7 to 14 is increasingly alkaline. Waters for domestic use are usually in the range of 5.5 to 8.5. Most well waters have a pH on the range of 6..5 - 8.5 while rain water tends to have a lower pH.
IMPORTANT: The acceptable level for drinking water is between 6.5 and 8.5. Corrosion of metal plumbing may occur at low pH values and 'scaling' or encrustation of metal pipes may occur at high pH values.

TURBIDITY: This is the measurement of the suspended particulate matter in the water which interferes with the passage of a beam of light through the water: the material could be silt, clay, organic material, or micro-organisms.

IMPORTANT: Turbidity values may be high during and after periods of high rainfall, as silt may then be washed into streams and wells. High levels of turbidity may protect micro-organisms from the effects of disinfection procedures. It may also stimulate the growth of bacteria and thus increase the chlorine demand (bleach) required to disinfect the water.

<u>ALKALINITY:</u> This is the measurement of the water's ability to neutralize acids. It usually indicates the presence of carbonates, bicarbonates, hydroxides, and/or other anions. Alkalinity results are expressed in terms of an equivalent amount of calcium carbonate. This does not mean, however, that carbonate was present in the water sample.
IMPORTANCE: Natural waters rarely exceed levels of 500mg/l. A range of 30 to 500 mg/l is acceptable, however, extreme variations, or high values may cause gastro-intestinal problems in humans.

<u>FLUORIDE (F):</u> Fluoride may be found in the water sample as a result of natural decomposition of rocks, or as a result of a community fluoridation program.
IMPORTANCE: Fluoride has been found to prevent tooth decay and consequently fluoridation programs have been established to treat water supplies. Excessive amounts of fluoride can result in mottled tooth enamel. The maximum acceptable level is 1.5 mg/l.

<u>HARDNESS: TOTAL:</u> This is the measurement of hardness in the water which is due to the presence of dissolved calcium and magnesium salts. Other metallic ions may contribute to hardness, however they are usually present in insignificant amounts. Hardness is expressed in terms of milligrams per litre (mg/l) of an equivalent amount of calcium carbonate,
IMPORTANCE: Water hardness can refer to the water's capacity to produce a lather with soap as the minerals react with the soap to produce insoluble curds; the harder the water, the less lather is produced. An acceptable level for hardness is between 80 to 100 mg/l. "Soft water" may have corrosive effects on plumbing, while "hard wtarewater" may result in scale deposits in pipes. If the water has a

hardness greater than 500mg/l it is probably unacceptable for most domestic purposes.

NITROGEN:NITRATE (NO3) as N : This is the measurement of the most oxidized form of nitrogen in the water sample.
IMPORTANCE: High nitrate values can decrease blood's oxygen carrying capacity. This is important with infants who may develop "methaemoglobinaemia". The maximum limit is 10.0 mg/l of (nitrate + nitrite) nitrogen. The objectives to be achieved is less than 0.001 mg/l.

NITROGEN :NITRITE (NO 2) as N : this is the measurement of an intermediate form of oxidization of the nitrogen in the water.

IMPORTANCE: The presence of nitrite generally indicates the water is undergoing active biological processes which can be caused by organic wastes or pollution. The maximum level acceptable is 1.0 mg/l.

CALCIUM (Ca): Calcium is quite common in water and contributes to the "hardness" of the water. Concentrations as high as 1800mg/l have proven harmless, but in some cases it may contribute to the formation of kidney stones in humans. The maximum acceptable concentration has been set at 200mg/l and the objective level at 75 mg/l.

IRON (Fe): This is the measurement of the dissolved and the particulate iron in the water.
IMPORTANCE: A limit of 0.3 mg/l has been set for aesthetic reasons. At levels above that iron may stain plumbing fixtures and clothing, it may give the water a bittersweet astringent taste, and it may contribute to scaling which can encrust pipes. Excessive amounts may also encourage bacterial growth which may be

observed as slimy coating in pipes, and contribute to the taste and odour of the water.

MAGNESIUM: Magnesium is reported to be non-toxic. It may be in the water as a result of the natural dissolving of rocks such as limestone and dolomite. It's presence in water is desirable because it contributes to palatability of the water. Magnesium is also beneficial for the heart and nervous system.. It can however, cause a mild laxative effect in some people until they become accustomed to the water, when they use a water source containing over 50 mg/l.

COLIFORMS: TOTAL:

INTRODUCTION: No bacteriological analysis of water can take the place of a complete knowledge of the conditions at the source of supply.

Contamination is often intermittent and may not be revealed by the examination of a single water sample. Therefore, if a sanitary inspection shows a water source to be obviously subject to pollution, the water should be considered unsafe irrespective of the results of bacteriological examination.

DEFINITION: The total coliform group (of micro-organisms) include fecal coliforms which are common to the intestinal tract of man and animals, and also nonfecal coliform organisms which have been found in soils and on vegetation.

IMPORTANCE: the precise sanitary significance of the total coliform test may be difficult to establish. Nonfecal coliform organisms tend to survive longer in water than either the fecal coliform or the commonly occurring bacterial disease organisms. The total coliform test is, therefore, offered as an indicator of bacterial contamination in the "Water Quality Check Program".

BARIUM: The maximum limit of 1.0mg/l has been set for barium because ingestion may cause toxic effects to the heart, blood vessels, and nerves. The toxic effects at low levels are still uncertain.

BORON: **The maximum limit has been set at 5.0 mg/l on the basis of health considerations. It can effect the central nervous system, gastro-intestinal tract, kidneys, liver, and skin. Children or adults with kidney problems are more susceptible.**

CHROMIUM (Cr): The maximum limit has been set at 0.05 mg/l for total chromium for health reasons. The toxic effects are attributed to hexavalent form of chromium. Chlorination may oxidize chromium in water to this form. Some chromium compounds are essential for biological reasons.

COPPER (Cu): The maximum limit has been set at 1.0 mg/l because of esthetic reasons. Copper is essential in human metabolism. Copper poisoning is rare. Levels of 1.0 mg/l may cause green stains on fixtures and may have an unpleasant taste. It may also contribute to corrosion of aluminum or zinc in plumbing.

MANGANESE (Mn): The maximum limit has been set at 0.05 mg/l for aesthetic reasons. At levels exceeding 0.15 mg/l it may stain plumbing fixtures and laundry. With iron, it may lead to accumulations of microbial growth in plumbing, and leave a black solid residue in the water.

ZINC (Zn):The maximum limit has been set at 5.0 mg/l for aesthetic reasons. It is an essential element and is considered non-toxic. Levels above 5.0 mg/l may be observed as an opalescent greasy film when the water is boiled and may impart an astringent taste.

NOTE: This information has been compiled and condensed from 2 sources : "Water Quality Check Program Interpretation Booklet" prepared by the Environmental Laboratory, Ministry of Environment and Parks, and the "Interpretation of a Water Analysis" booklet prepared by British Columbia Ground Water Association. Neither booklet ~~were~~ available for distribution for our

workshop purposes. This has been compiled for your information only, and not to be used as a definitive resource.