State Of Water Quality Of Unuk River Near U.S. Border 1991-1993

Environment Environnement
Canada Canada

Ministry Of Environment,
Lands And Parks

Canada - British Columbia
Water Quality Monitoring Agreement

State Of Water Quality Of
Unuk River Near U.S. Border
1991-1993

Water Quality Section
Water Management Branch
Ministry Of Environment, Lands And Parks

Monitoring And Systems Branch
Pacific And Yukon Region
Environment Canada

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Executive Summary

The Unuk River is located in northwest British Columbia, flowing southwest to Alaska and the Pacific Ocean (Figure 1). Proposed and active mining projects are located within the Unuk River watershed. Also, the Unuk is important to sport and commercial fishing, mainly in the Alaskan portion of the river.

This report assesses water quality data collected at the monitoring station 3 km upstream from the Alaska border and 65 km northwest of Stewart, B.C. Water quality samples were collected between 1991 and 1993 by Environment Canada. Flow was measured at a Water Survey of Canada flow gauge at the water quality monitoring station.

We concluded that:

· Not enough data were available to comment on trends in water quality, although a slight downward trend in pH was apparent.
· High metals and non-filterable residue occurred together. This suggests that metals were in a particulate form, probably not biologically available, and would be removed by the turbidity removal needed before drinking.
· Total aluminum, cadmium, chromium, copper, iron, lead, manganese and zinc, apparent colour, non-filterable residue and turbidity values did not meet various water quality criteria at times due to high levels of suspended sediment in the water during freshet.
· Copper levels exceeded the aquatic life criteria at all times, suggesting a naturally high copper mineralization in the watershed.
· The river had a low sensitivity to acid inputs.
· Hardness levels were generally below the optimum range for drinking water in the summer and within the optimum range in the winter.
· Treatment to remove turbidity (plus disinfection) would be necessary before the water was used for drinking.
· The water was cool enough to be aesthetically pleasing for drinking, but too cold for water-contact recreation such as swimming.

We recommend that reactivation of water quality monitoring be considered for the Unuk River near the U.S. border because:

· It is a trans-boundary river that supports an important fishery.
· There are active and potential mine sites within the watershed.
· The watershed is relatively small (1480 km^2) and thus potentially sensitive to change.
· The existing baseline water quality record is short and sparse.
· The forthcoming road construction will improve access for the purpose of monitoring.

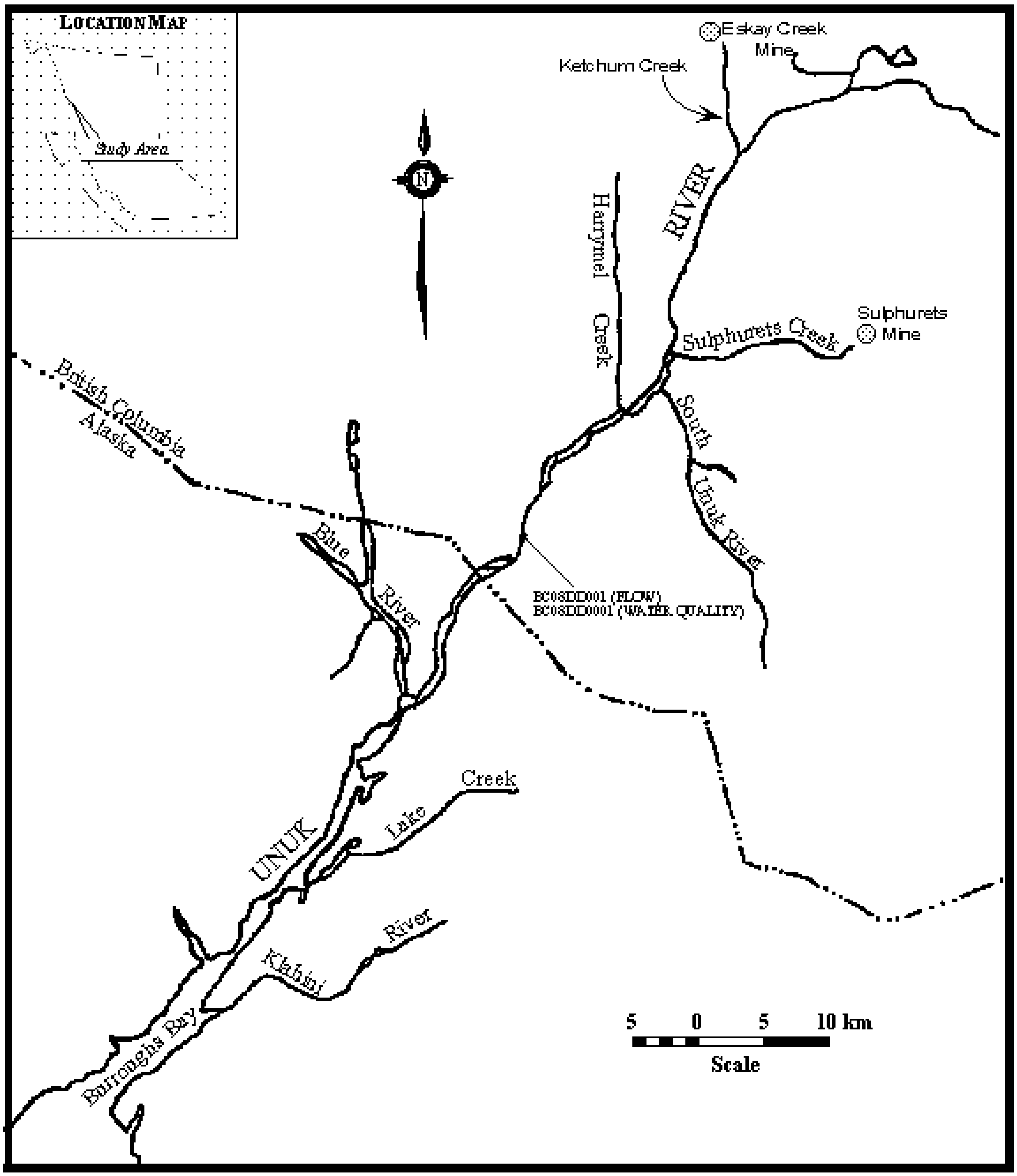

Figure 1 Map of Unuk River (Scale 1:500 000)

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Introduction

The Unuk River is located in northwest British Columbia. The river flows southwest, across the Alaska border and into the Pacific Ocean. There are no major tributaries flowing into the Unuk. The Unuk River is under ice from October to April.

The water quality monitoring station is located 3 km upstream from the Alaska border and 65 km northwest of Stewart, B.C. The Eskay Creek Mine (Homestake) discharges into Ketchum Creek, which flows into the Unuk River near the northern part of the watershed. Some mining at the Sulphurets property near the headwaters of Sulphurets Creek has commenced recently. The Unuk River is important for both commercial and sport fishing, with the majority of fish found in the Alaskan portion of the river.

Data for this report are from bi-monthly sampling by Environment Canada between 1991 and 1993 and are stored under ENVIRODAT station number BC08DD0001. The water quality indicators are plotted in Figures 3 to 47. Water Survey of Canada operated a flow gauge (site number BC08DD001) at the water quality monitoring station. The drainage area at the flow station is 1480 km^2. Flow data are graphed in Figure 2. Water quality monitoring was terminated in October, 1993 due to the termination of flow monitoring (water quality samples were collected by the hydrometric technicians).

Quality Assurance

The water quality graphs were inspected and erroneous values were removed. Mercury data were not plotted because all detectable values were likely due to contamination (Pommen, 1994). Quality assurance issues are discussed in further detail in the next section.

State of the Water Quality

The state of the water quality was judged by comparing values to the Ministry of Environment, Lands and Parks' Approved and Working Criteria for Water Quality (Nagpal *et al.*, 1995). With only three years of samples, the record is too short and sparse to comment on any trends. The following 24 water quality indicators were not discussed as they easily met all water quality criteria and showed no clearly visible trends: alkalinity, arsenic, barium, beryllium, calcium, carbon (total inorganic), chloride, cobalt, cyanide (total and weak-acid dissociable), conductivity, fluoride, lithium, magnesium, molybdenum, nickel, nitrate/nitrite, total dissolved nitrogen, potassium, filterable residue, fixed filterable residue, fixed non-filterable residue, selenium, silica, sodium, strontium, sulphate and vanadium.

Flow (Figure 2) values were highest during snowmelt freshet (April-July) and fall rains (September-October).

Total alkalinity (Figure 3) and **calcium** (Figure 9) concentrations indicated a low sensitivity to acid inputs.

Total aluminum (Figure 4) values exceeded the 5 mg/L total aluminum criterion for wildlife, livestock and irrigation only once (July 4, 1991) during freshet when non-filterable residue was high. This suggests that aluminum was in a particulate form and was probably not biologically available. Dissolved aluminum should also be measured to permit comparisons to criteria for drinking water and aquatic life.

Total cadmium (Figure 8) had a minimum detectable limit (0.0001 mg/L) 3 to 10 times above the aquatic life criteria (0.00001 mg/L, 0.00003 mg/L). Most high cadmium values corresponded to periods of high non-filterable residue. This suggests that cadmium was in a particulate form and probably not biologically available. To evaluate the aquatic life criteria accurately, the minimum detectable limit should be lowered to at least one-tenth of the lowest criterion, and dissolved cadmium should also be measured.

Total organic carbon (Figure 11) values exceeded the 4 mg/L criterion for drinking water once (May 6, 1992). Dissolved organic carbon should be measured due to its role in influencing the toxicity of metals.

Total chromium (Figure 13) exceeded the 0.002 mg/L criterion for phyto- and zoo-plankton 44% of the time. No values exceeded the 0.02 mg/L criterion for fish or the 0.05 mg/L criterion for drinking water. High chromium and non-filterable residue occurred together. This suggests that chromium was in a particulate form and probably not biologically available. Dissolved chromium should also be measured in the future.

Apparent colour (Figure 15) values were highest in the summer and near the minimum detectable limit (5 units) in the winter. The 15-unit drinking water and recreation criterion for true colour was met at least 62% of the time. No values exceeded the 100-unit recreation (maximum) criterion. All criteria are given as true colour values, where turbidity is removed before measurement. High apparent colour values occurred in samples with high turbidity, and thus true colour would have been much lower. True colour should be measured at the site to compare the data to the criteria effectively.

Total copper (Figure 16) exceeded both the upper (0.004 mg/L) and lower (0.002 mg/L) aquatic life criteria in all samples. High copper and non-filterable residue occurred together. This suggests that copper was in a particulate form and probably not biologically available. However, copper exceeded the criteria even when non-filterable residue and turbidity were low, indicating that the Unuk River had naturally high copper levels. Dissolved copper should also be measured in the future.

Hardness (Figure 20) samples were within the optimum range for drinking water (80-100 mg/L as $CaCO_3$) 19% of the time. Eighty-one percent of the values were below this range, but still quite acceptable (soft) for drinking water. Lowest hardness values took place in the summer and highest values occurred in the winter, reflecting the increased proportion of harder ground water during winter low flows.

Total iron (Figure 21) exceeded the 5 mg/L criterion for irrigation 19% of the time, while the 0.3 mg/L drinking water and aquatic life criteria were exceeded 81% of the time. High values of iron and non-filterable residue occurred together. This suggests that iron was in a particulate form and probably not biologically available. Also, the particulate iron would be removed during drinking water treatment needed to remove the turbidity caused by the particulate matter. Dissolved iron should be measured in the future.

Total lead (Figure 22) values exceeded the 0.006 mg/L upper criterion for aquatic life twice (July 4, 1991 and May 18, 1993) and exceeded the 0.004 mg/L lower criterion four times. High lead and non-filterable residue occurred together. This suggests that lead was in a particulate form and probably not biologically available. Total and dissolved lead should be measured in the future.

Total manganese (Figure 25) exceeded the 0.2 mg/L criterion for irrigation once (July 4, 1991). Also, the 0.1 mg/L criterion for aquatic life was exceeded 19% of the time and the 0.05 mg/L criterion for drinking water was exceeded 44% of the time. High manganese and non-filterable residue occurred together. This suggests that manganese was in a particulate form and probably not biologically available. Also, manganese would be removed by the water treatment needed to remove turbidity prior to drinking. Dissolved manganese should also be measured in the future.

pH (Figure 30) exhibited a slight downward trend, although the data are sparse and the record is short. All criteria were met.

Non-filterable residue (Figure 34) values exceeded the 25 mg/L criterion for good fisheries 44% of the time, although this criterion may not be applicable to all mountain and northern streams. **Total phosphorus** (Figure 31) reported higher values corresponding to high non-filterable residues. This suggests that total phosphorus was in a particulate form and not biologically available. Higher non-filterable residues were associated with higher flows.

Water temperature (Figure 44) did not exceed the 15°C upper aesthetic limit for drinking water and the lower limit for recreation. This means that the water was cool enough to be aesthetically pleasing for drinking, but too cold for water-contact recreation such as swimming.

Turbidity (Figure 45) values exceeded the 50 NTU criterion for recreation twice (July 4, 1991 and May 18, 1993). The 5 NTU aesthetics criterion for drinking water was exceeded 56% of the time, and the 1 NTU health criterion for drinking water was exceeded 88% of the time. Higher turbidity values were associated with higher flows. Turbidity removal and disinfection are required prior to drinking water use.

Total zinc (Figure 47) exceeded the 0.03 mg/L fish and invertebrates criterion twice (July 4, 1991 and May 18, 1993). Also, 38% of the values exceeded the 0.015 mg/L algae criterion. High zinc and non-filterable residue occurred together. This suggests that zinc was in a particulate form and probably not biologically available.

Conclusions - State of Water Quality

· Not enough data were available to comment on trends in water quality, although a slight downward trend in pH was apparent.
· High metals and non-filterable residue occurred together. This suggests that metals were in a particulate form, probably not biologically available, and would be removed by the turbidity removal needed before drinking.
· Total aluminum, cadmium, chromium, copper, iron, lead, manganese and zinc, apparent colour, non-filterable residue and turbidity values did not meet various water quality criteria at times due to high levels of suspended sediment in the water during freshet.
· Copper levels exceeded the aquatic life criteria at all times, suggesting a naturally high copper mineralization in the watershed.
· The river had a low sensitivity to acid inputs.
· Hardness levels were generally below the optimum range for drinking water in the summer and within the optimum range in the winter.
· Treatment to remove turbidity (plus disinfection) would be necessary before the water was used for drinking.
· The water was cool enough to be aesthetically pleasing for drinking, but too cold for water-contact recreation such as swimming.

Recommendations for Water Quality Management

Remediation

· No remedial activities appear to be necessary at this time.

Monitoring

We recommend that reactivation of water quality monitoring be considered for the Unuk River near the U.S. border because:

· It is a trans-boundary river that supports an important fishery.
· There are active and potential mine sites within the watershed.
· The watershed is relatively small (1480 km^2) and thus potentially sensitive to change.
· The existing baseline water quality record is short and sparse.
· The forthcoming road construction will improve access for the purpose of monitoring.

Figure 2 Flow

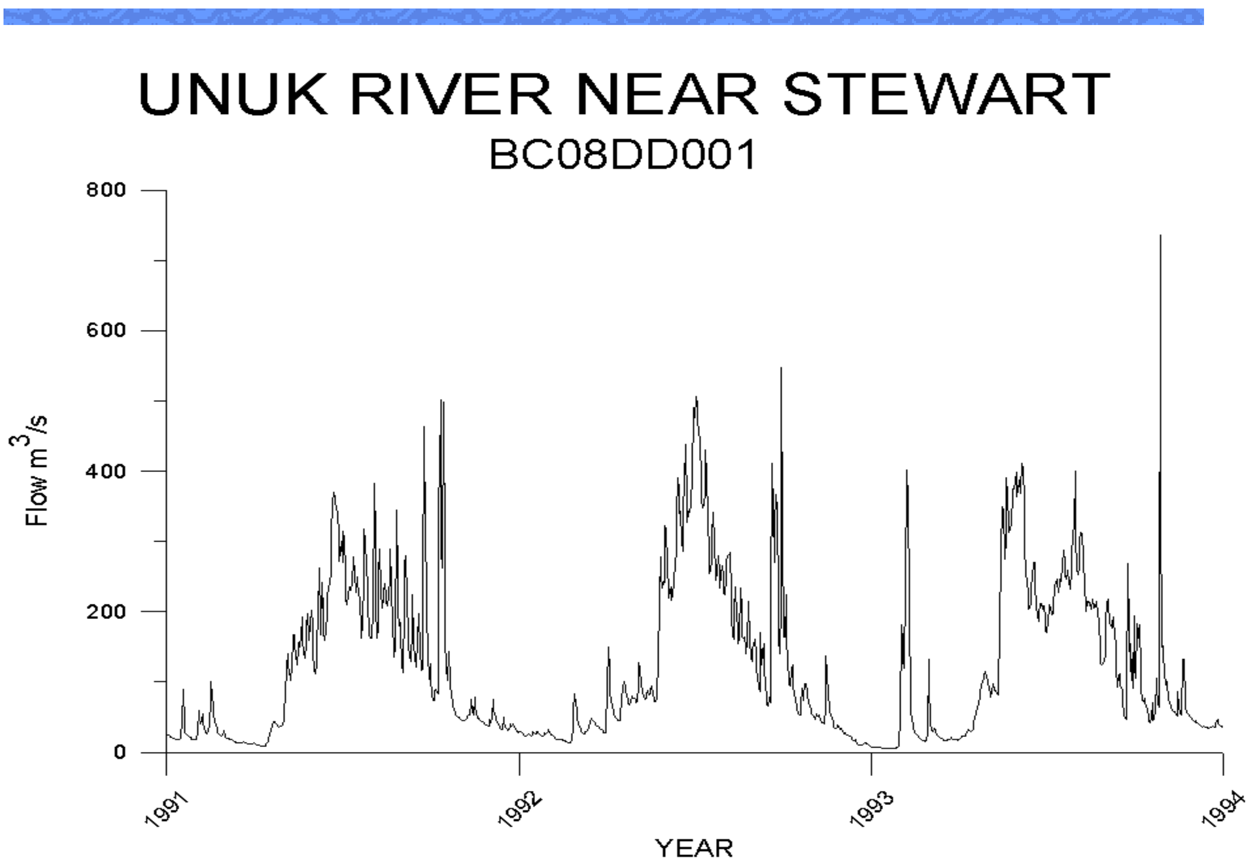


Figure 3 Total Alkalinity

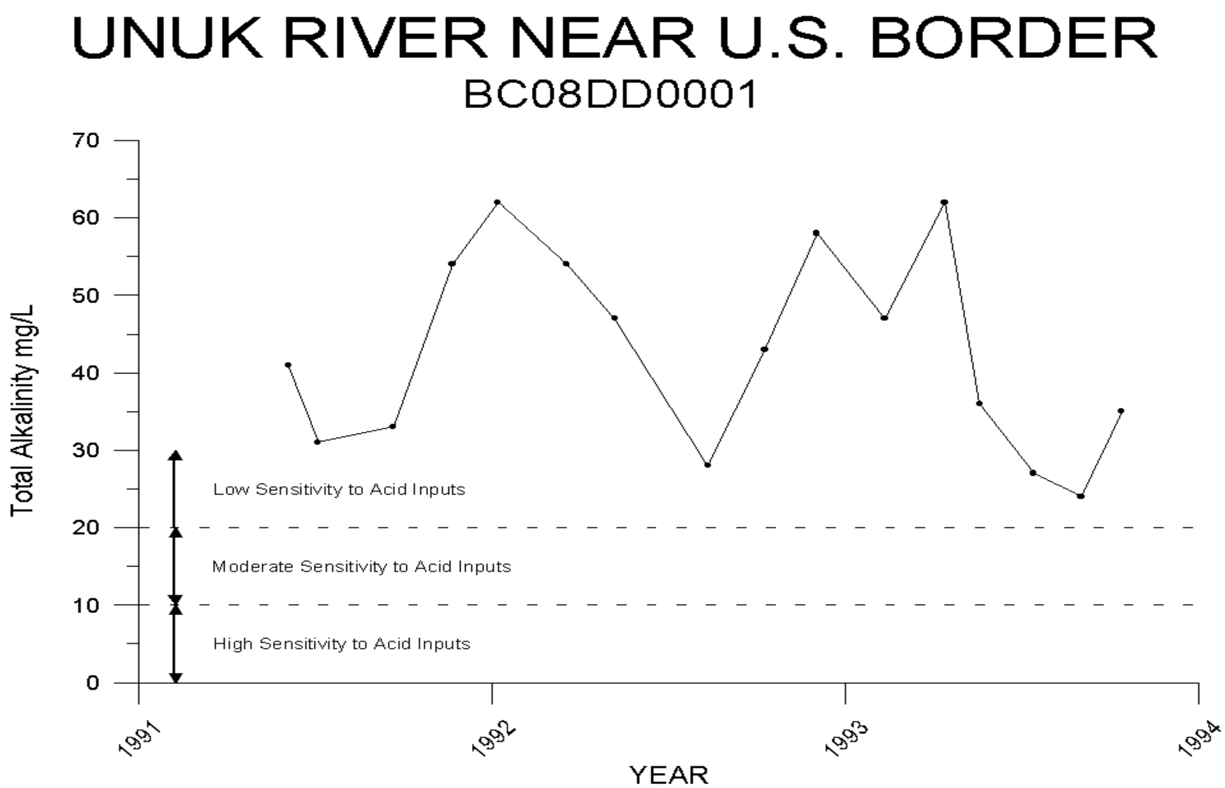


Figure 4 Total Aluminum

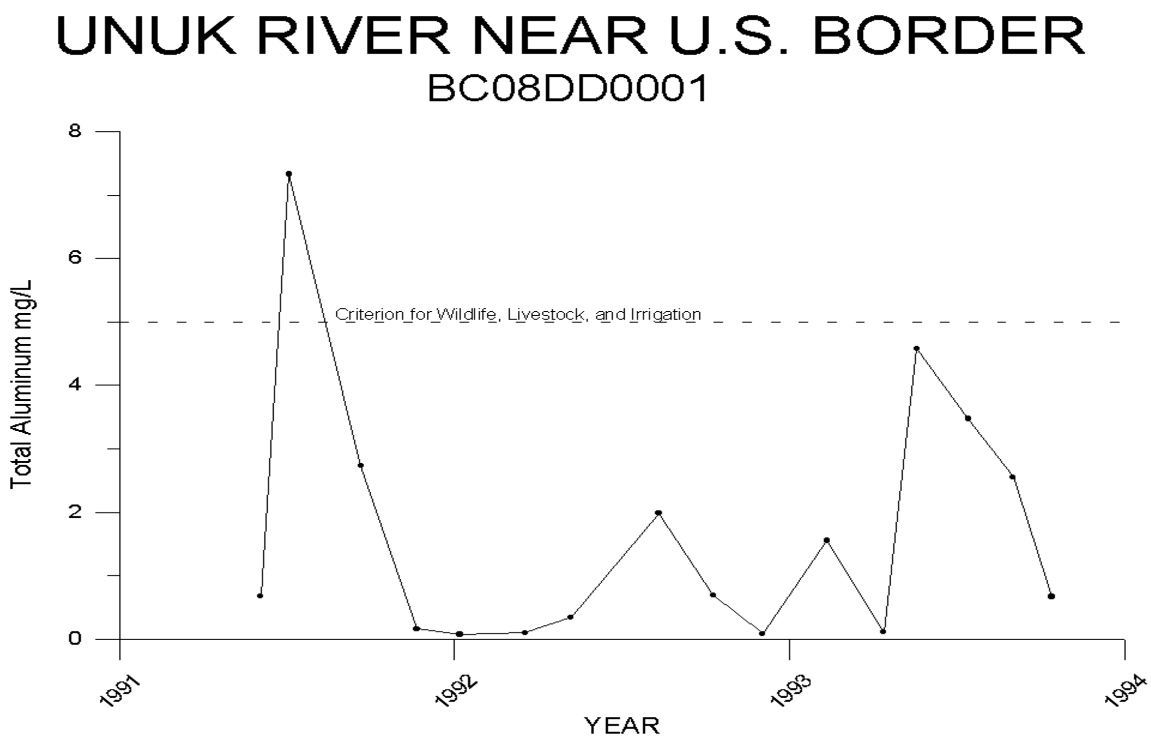


Figure 5 Total Arsenic

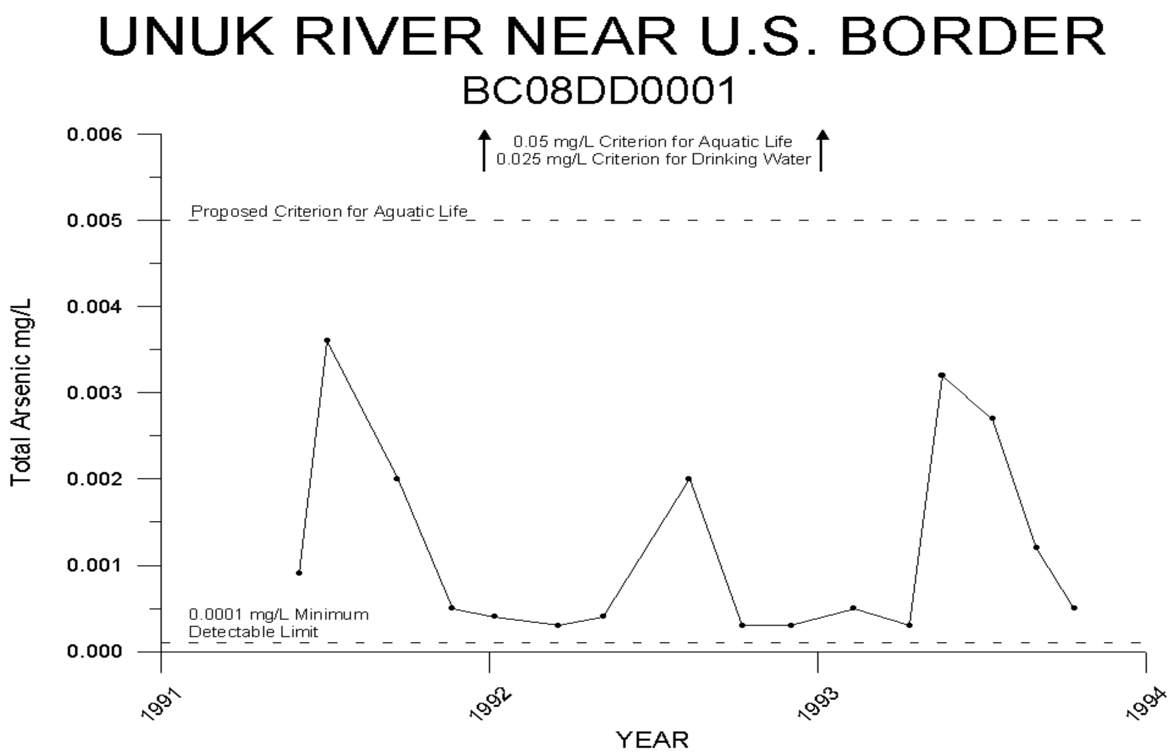


Figure 6 Total Barium

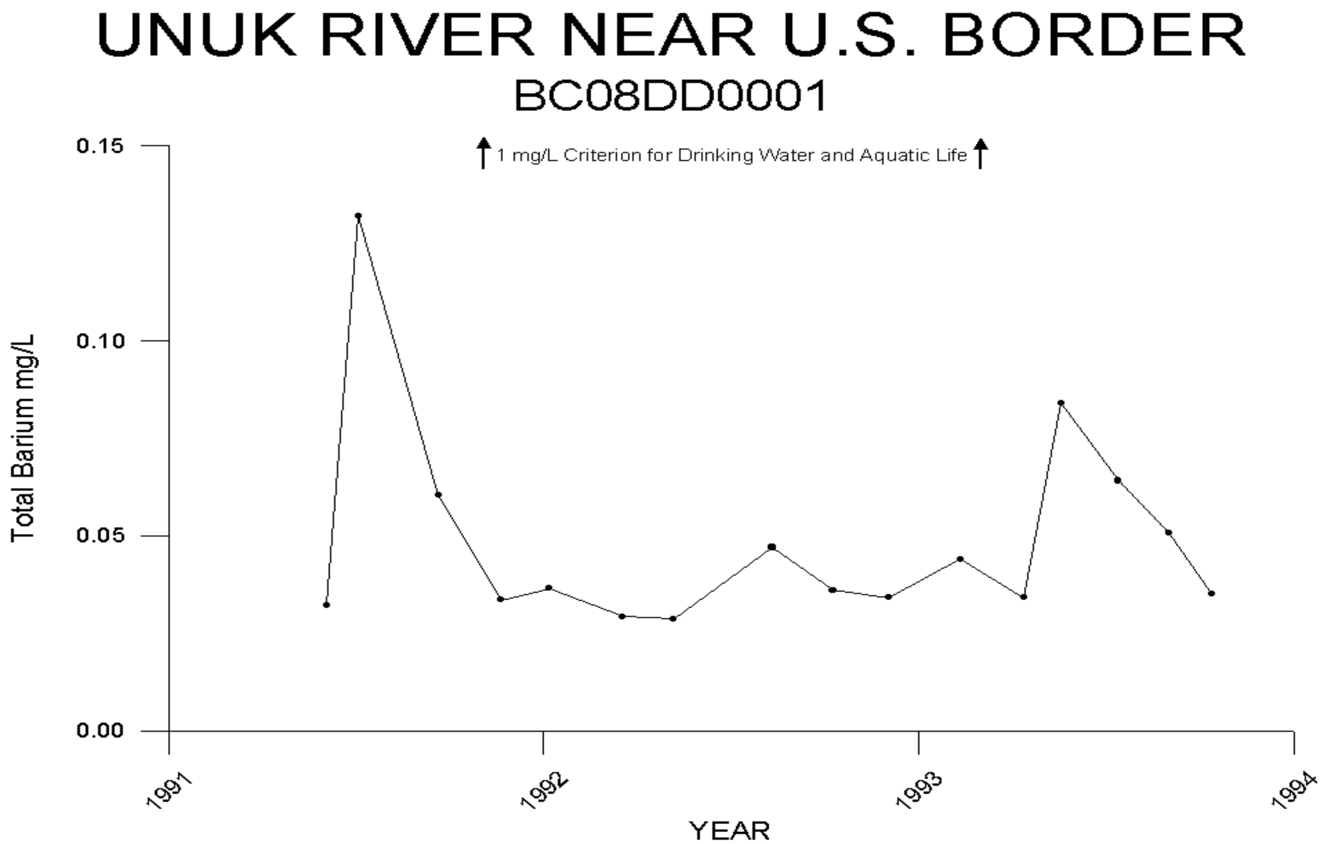


Figure 7 Total Beryllium

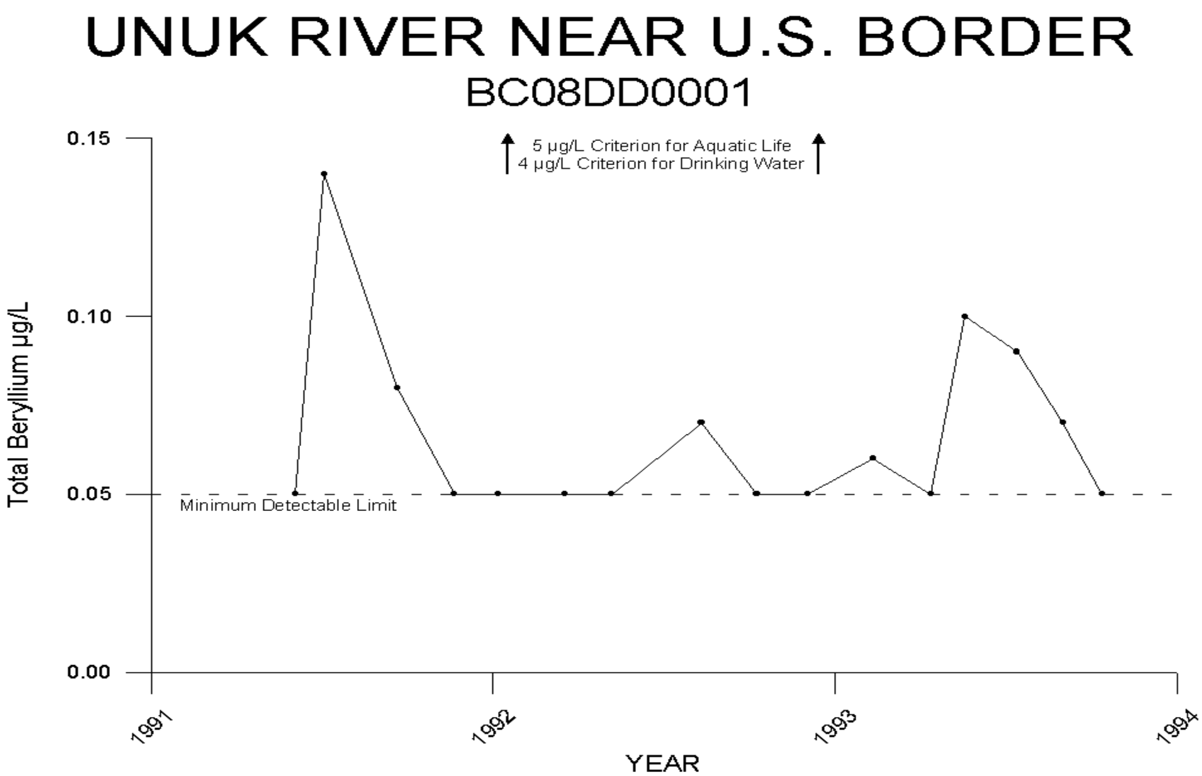


Figure 8 Total Cadmium

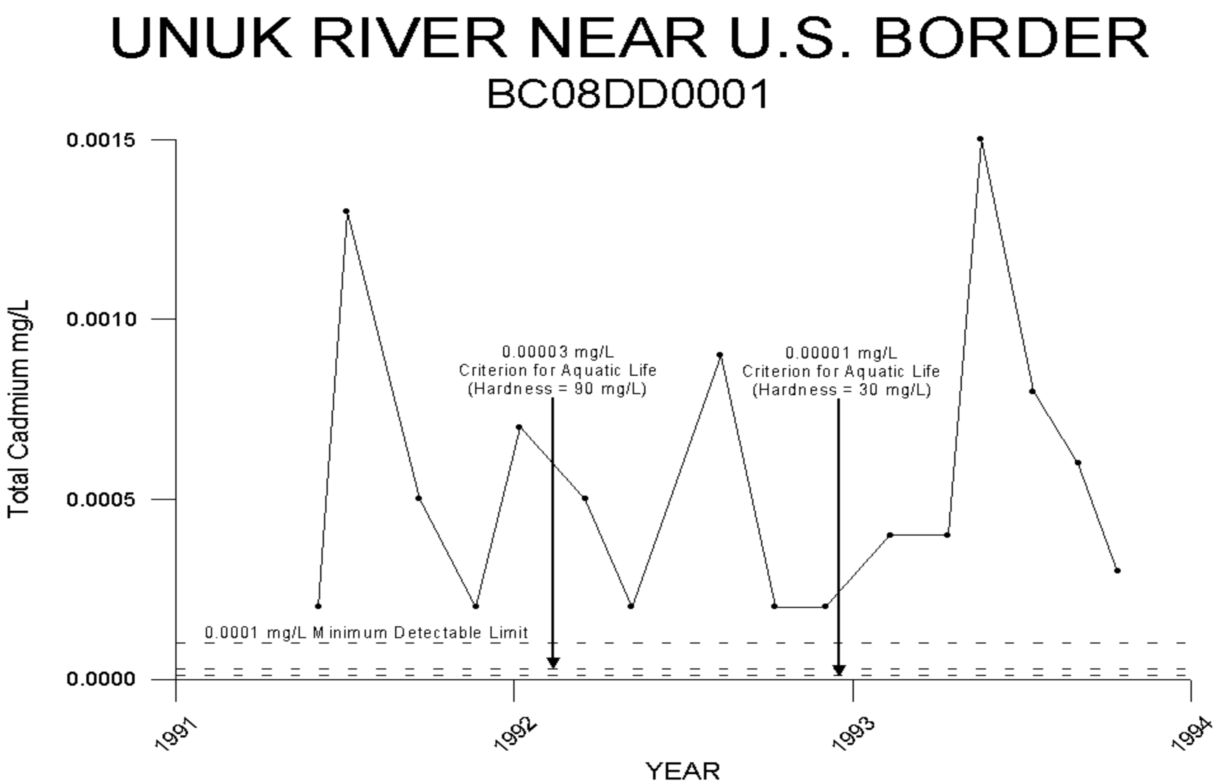


Figure 9 Calcium

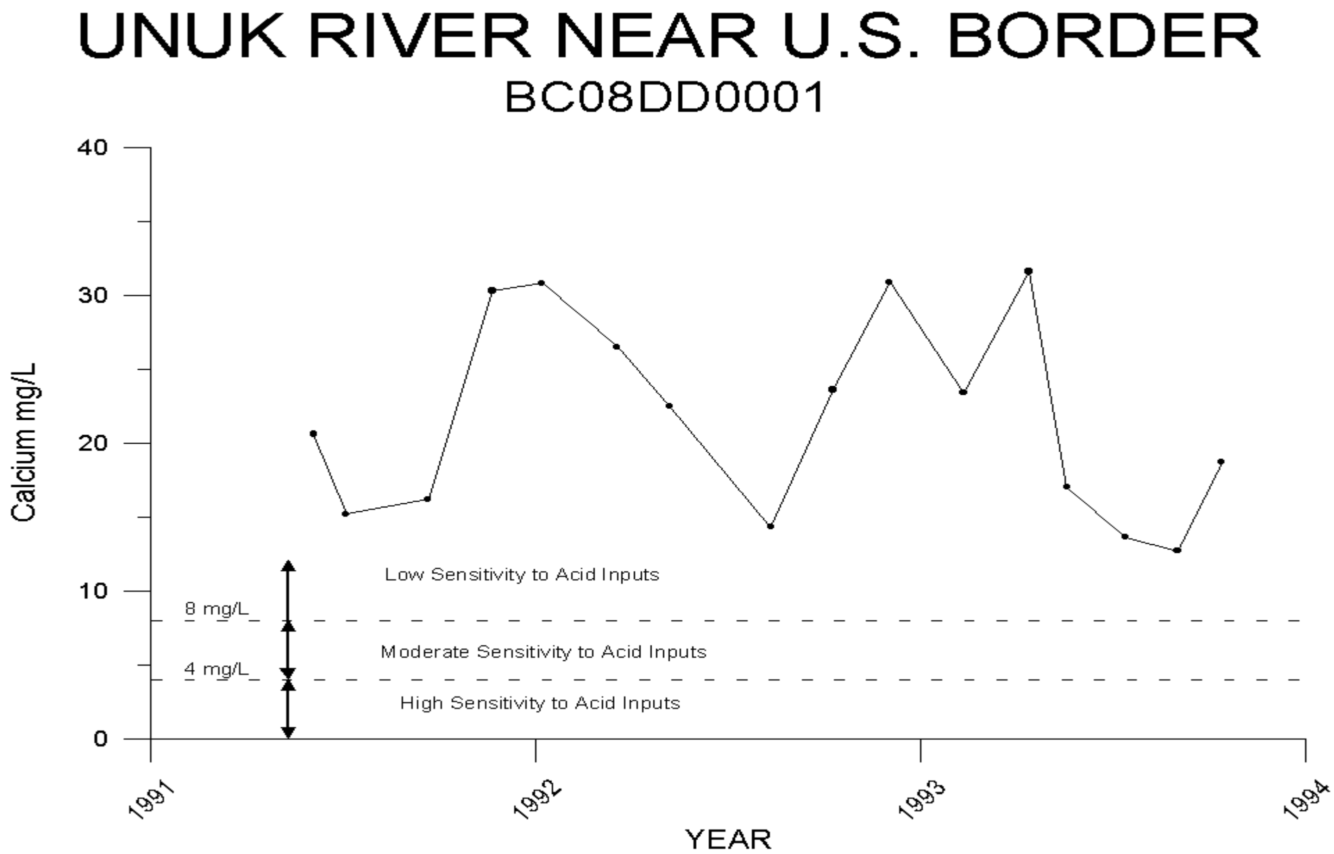


Figure 10 Total Inorganic Carbon

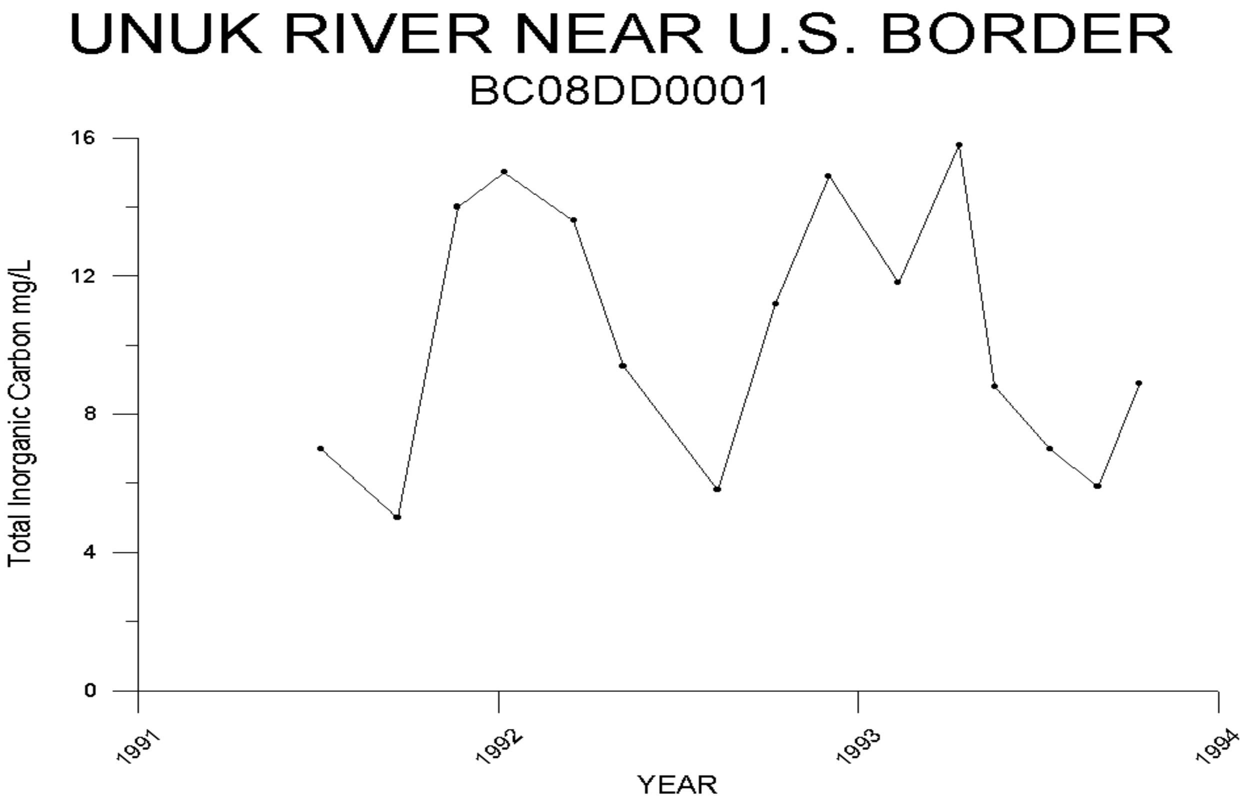


Figure 11 Total Organic Carbon

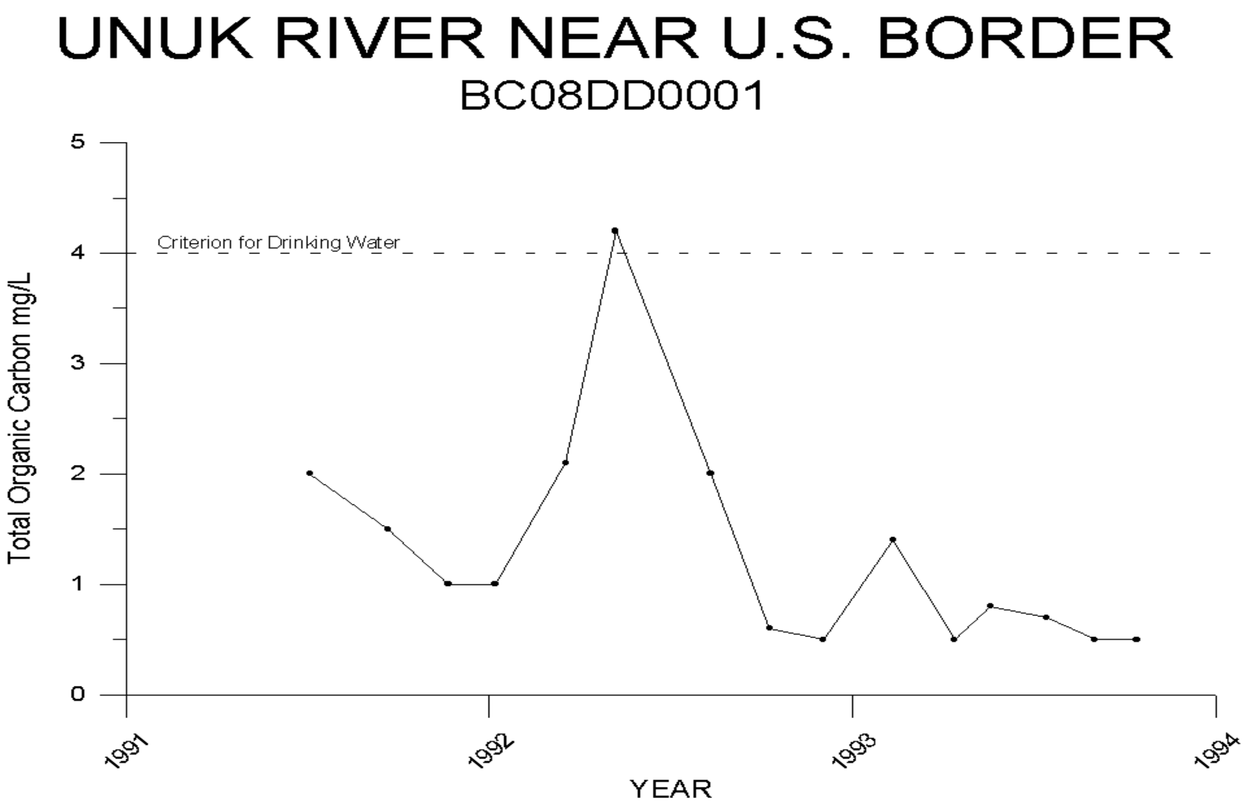


Figure 12 Dissolved Chloride

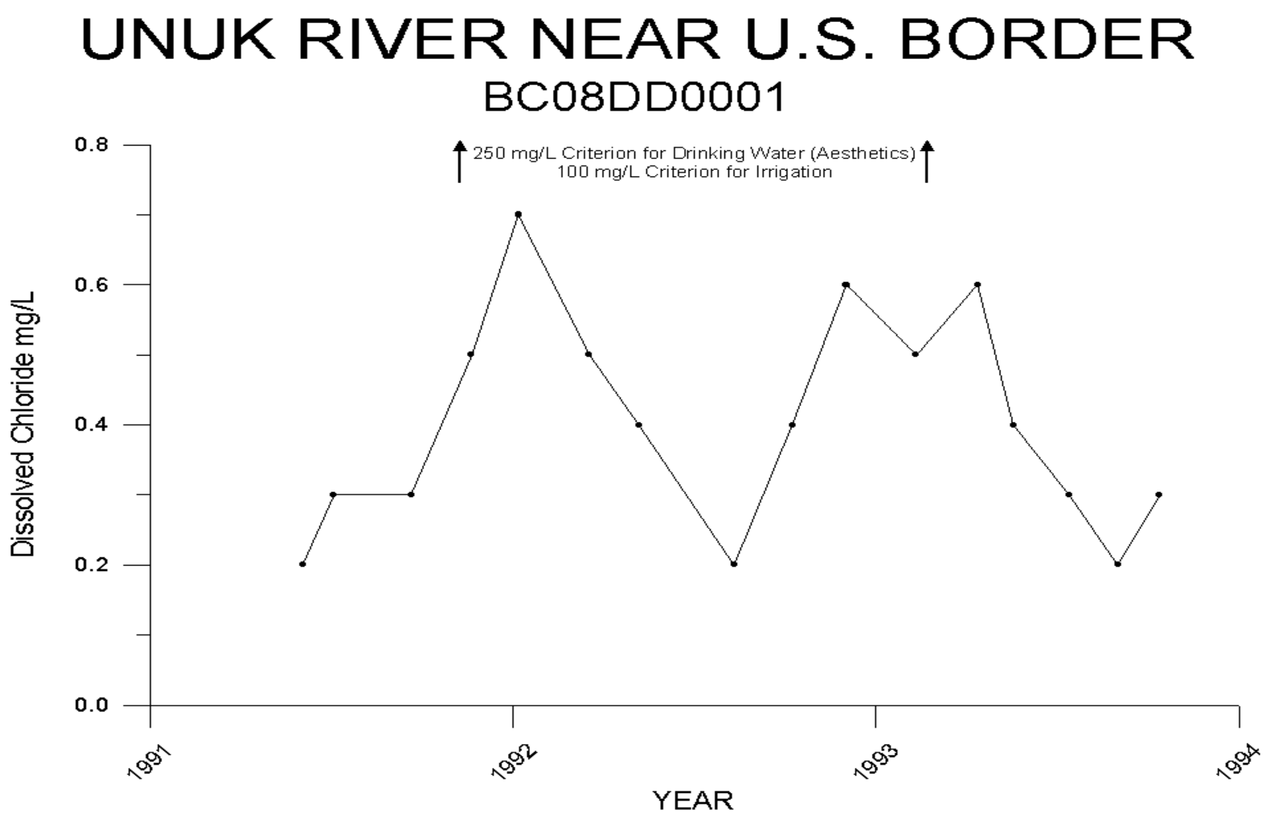


Figure 13 Total Chromium

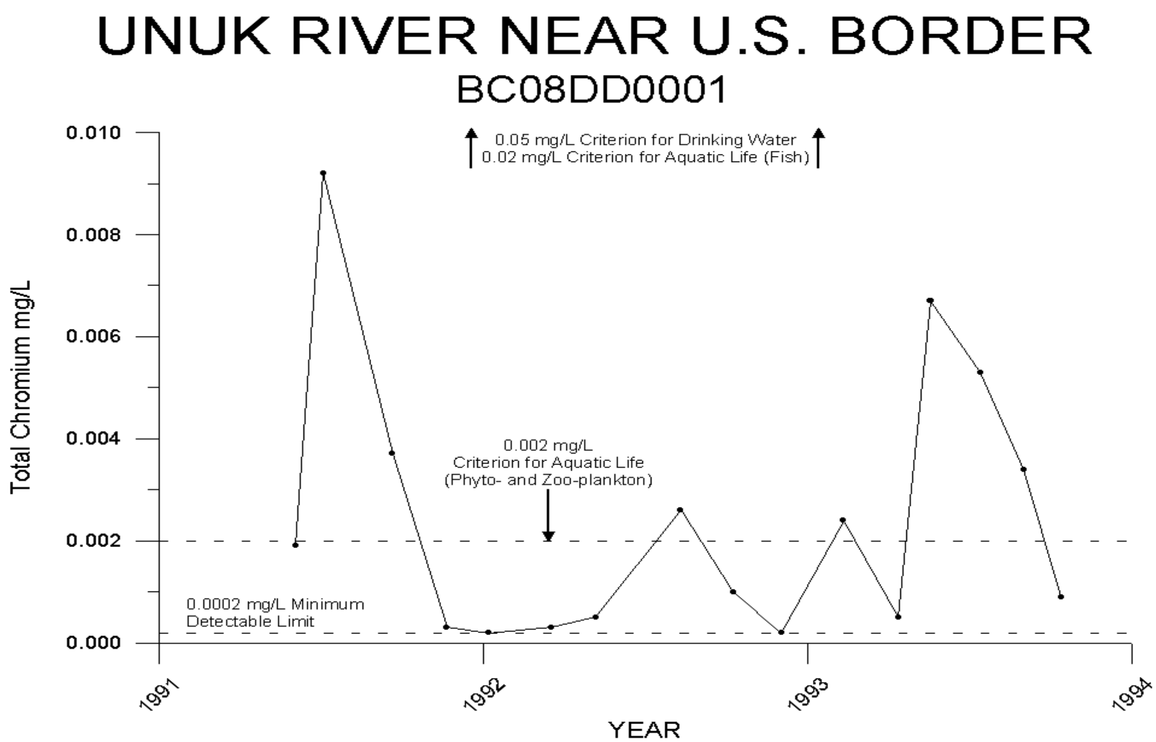


Figure 14 Total Cobalt

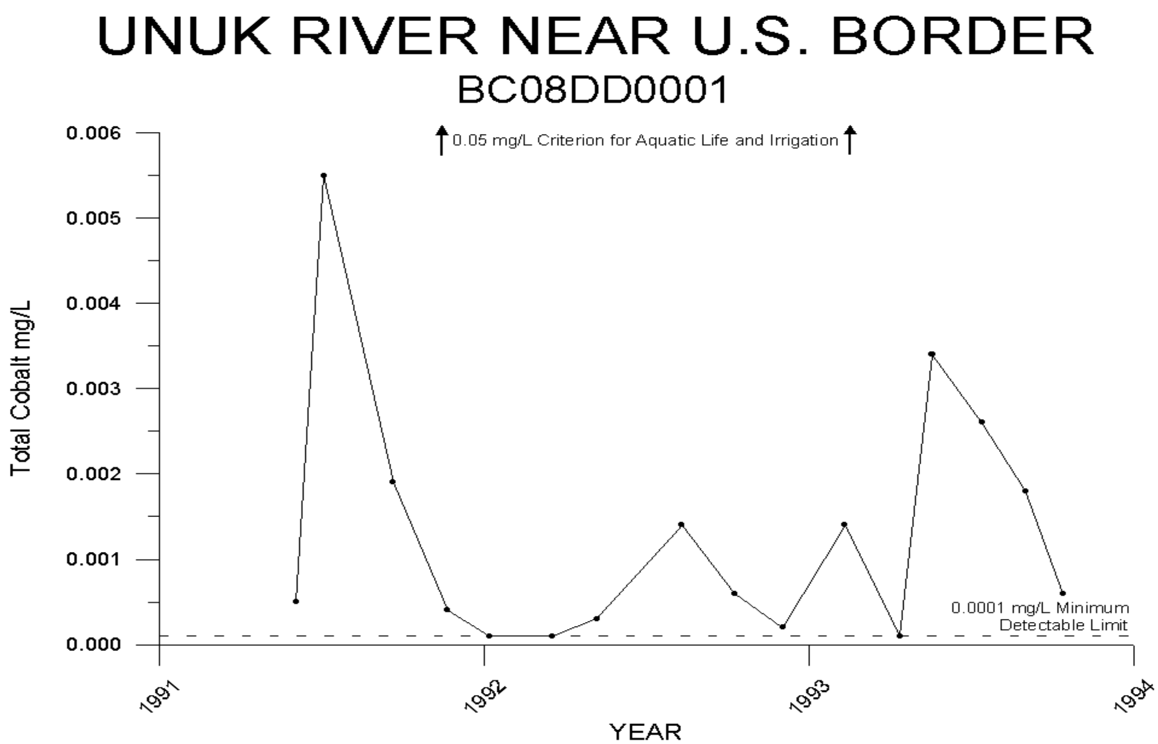


Figure 15 Apparent Colour

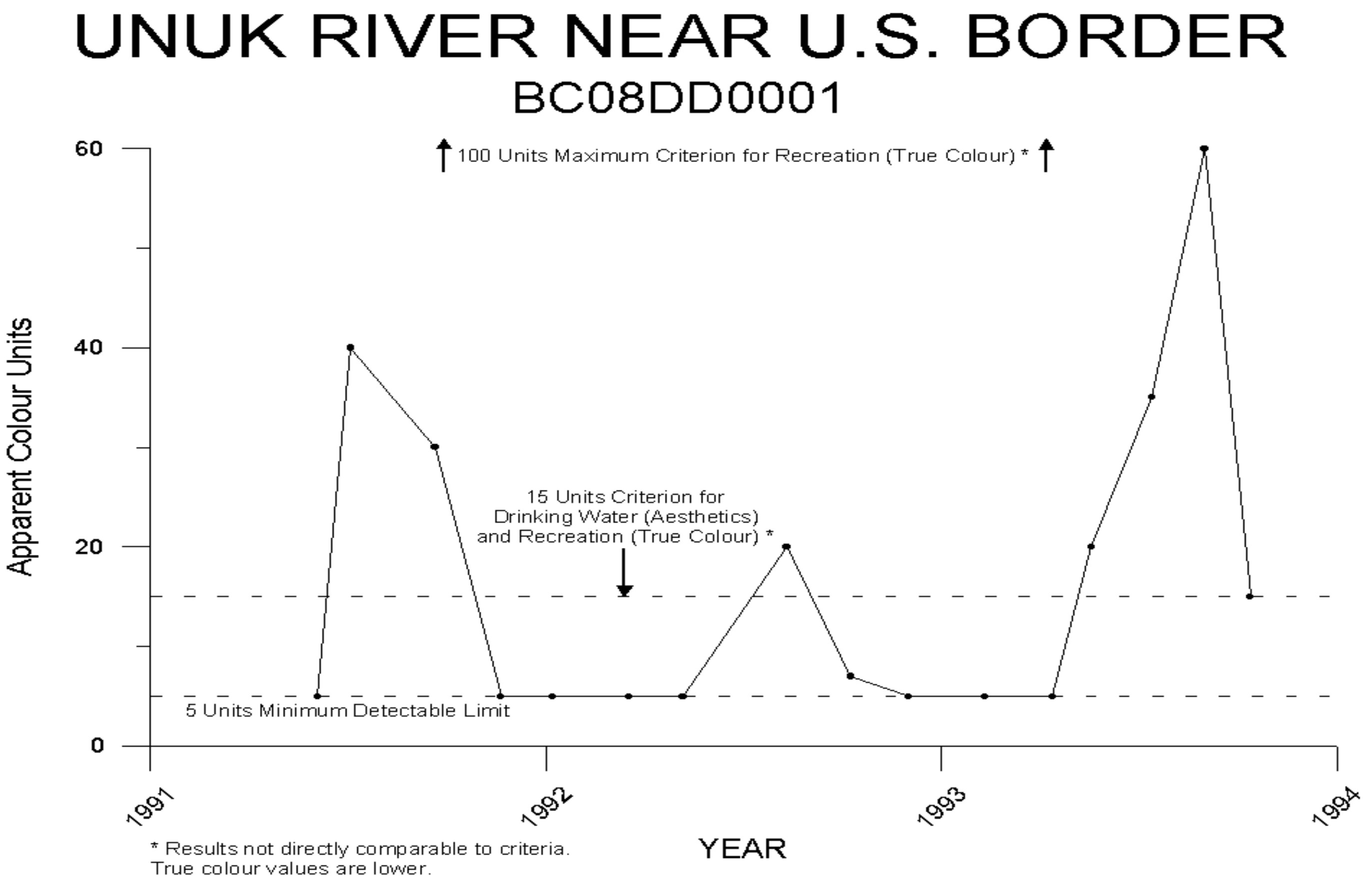


Figure 16 Total Copper

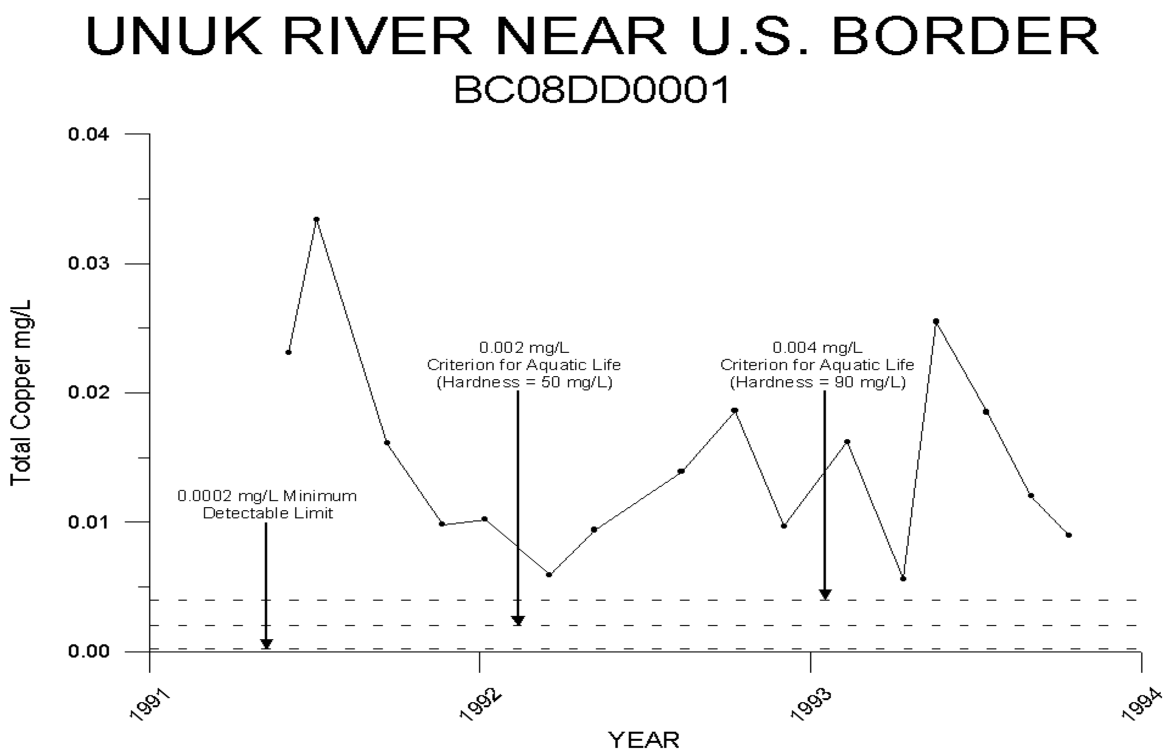


Figure 17 Total Cyanide

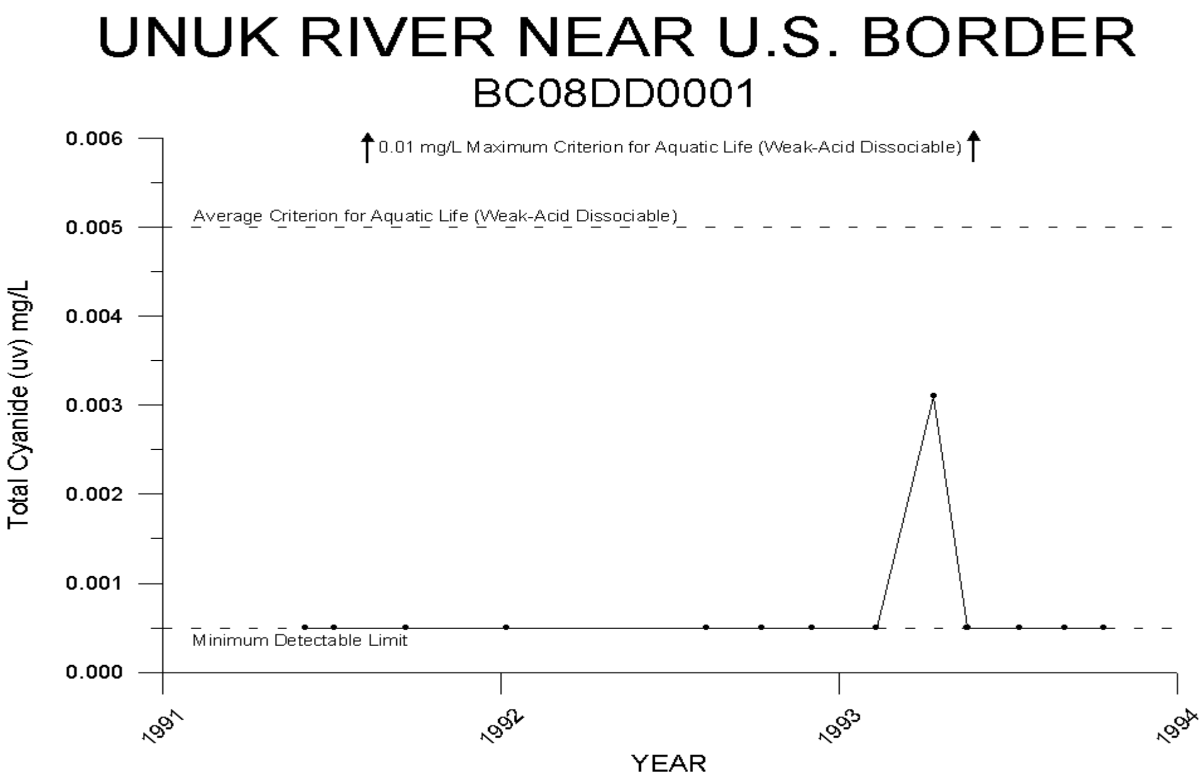


Figure 18 Cyanide (Weak-Acid Dissociable)

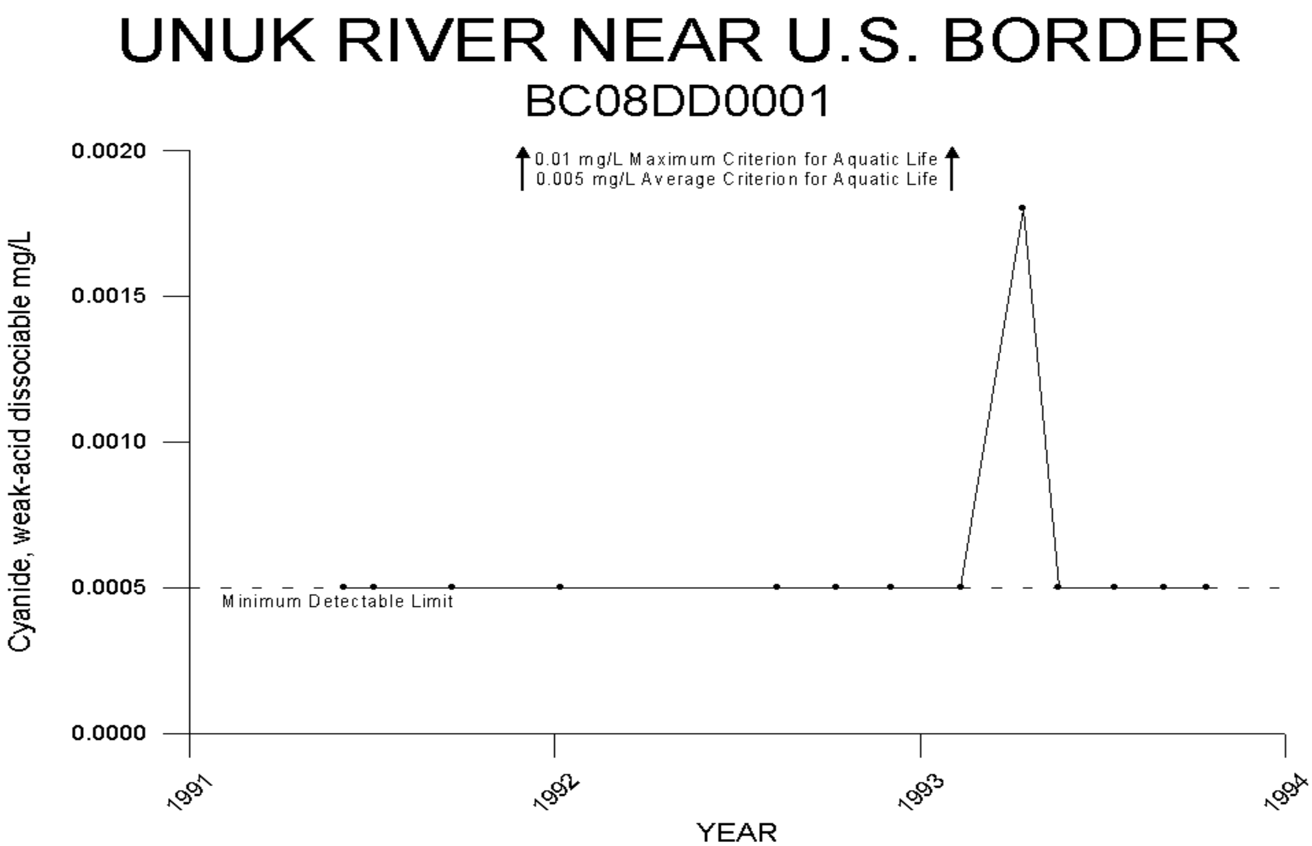


Figure 19 Dissolved Fluoride

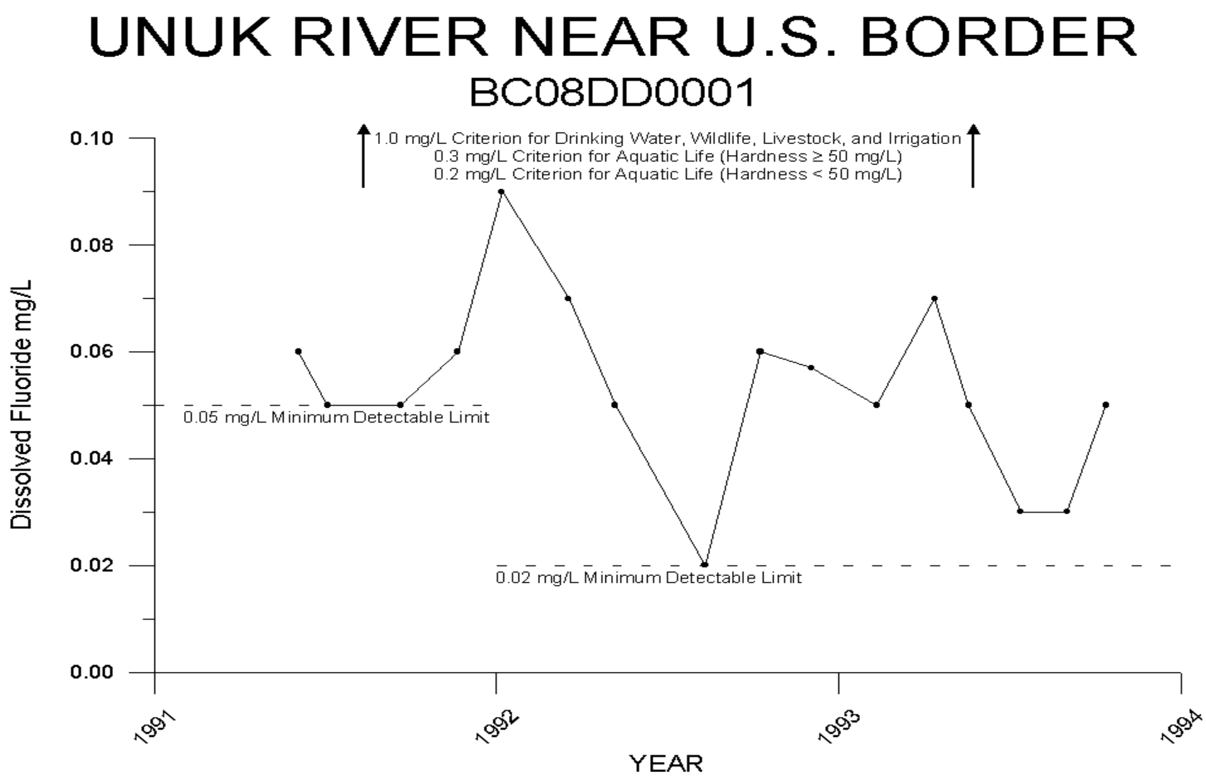


Figure 20 Hardness

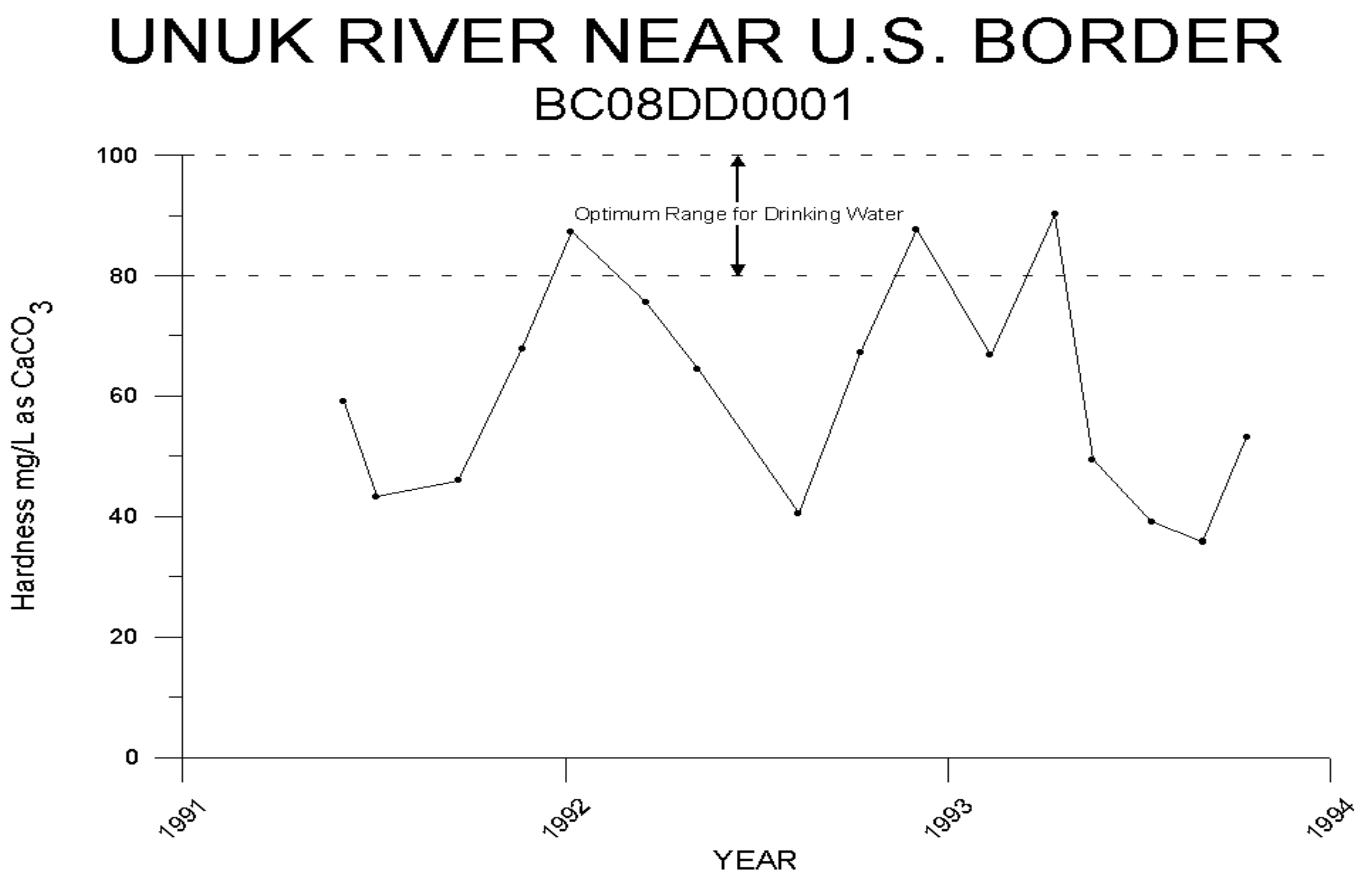


Figure 21 Total Iron

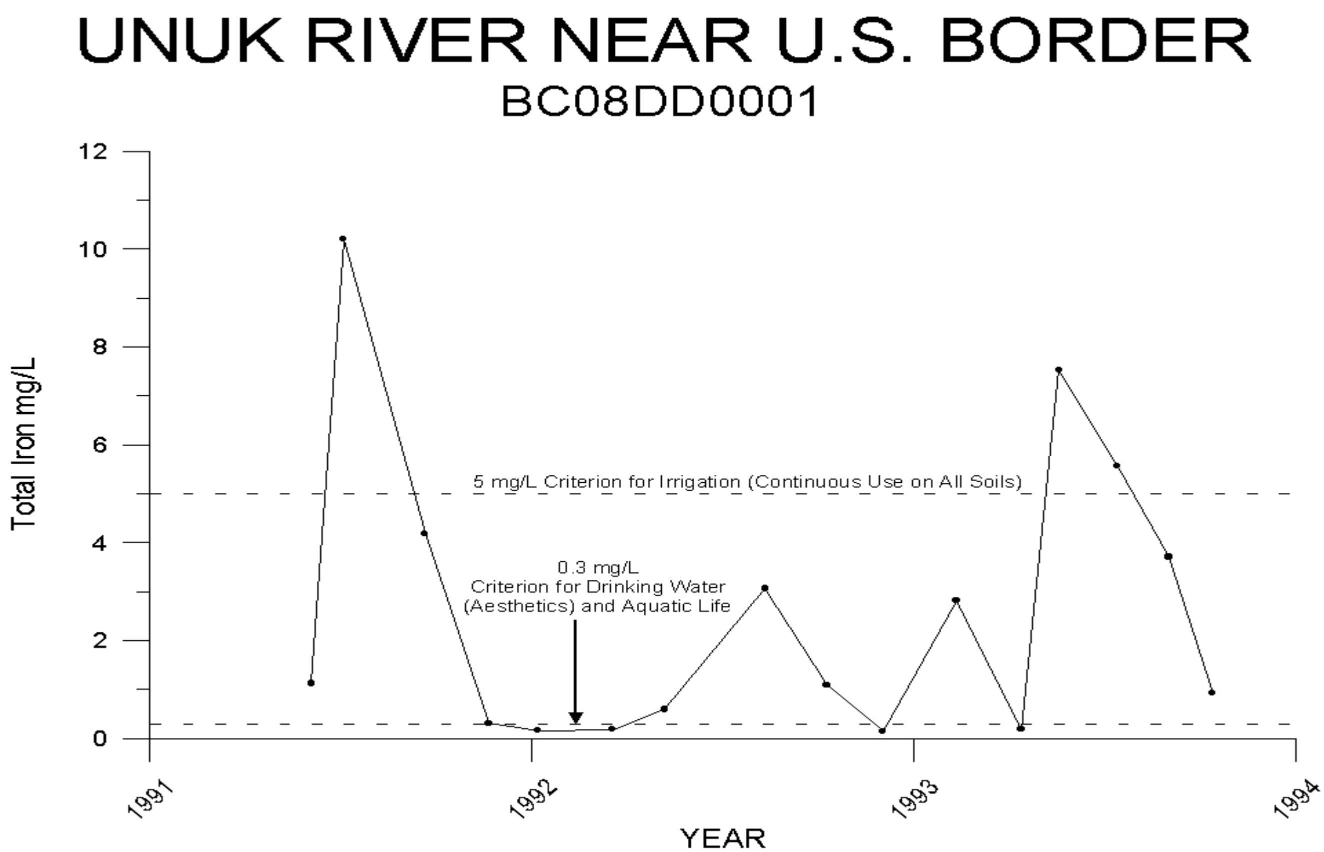


Figure 22 Total Lead

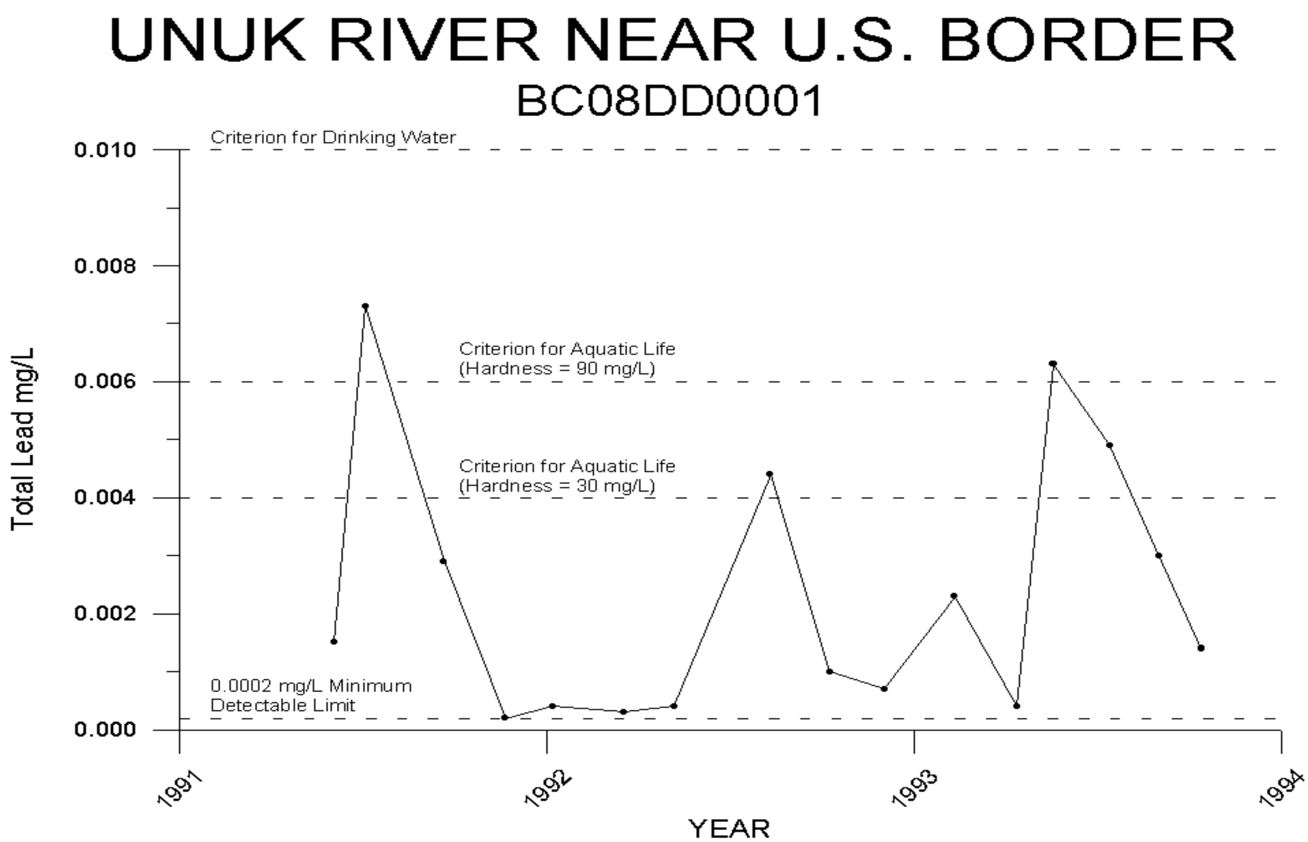


Figure 23 Total Lithium

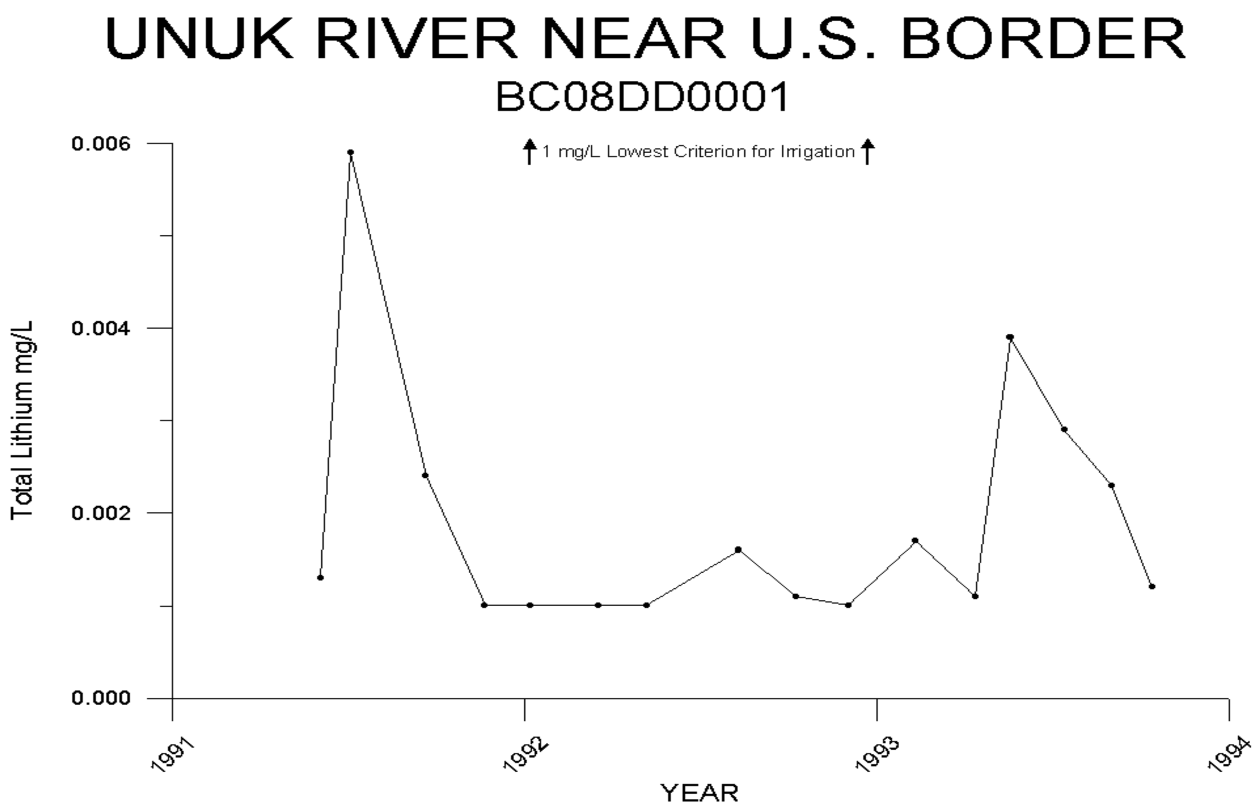


Figure 24 Magnesium

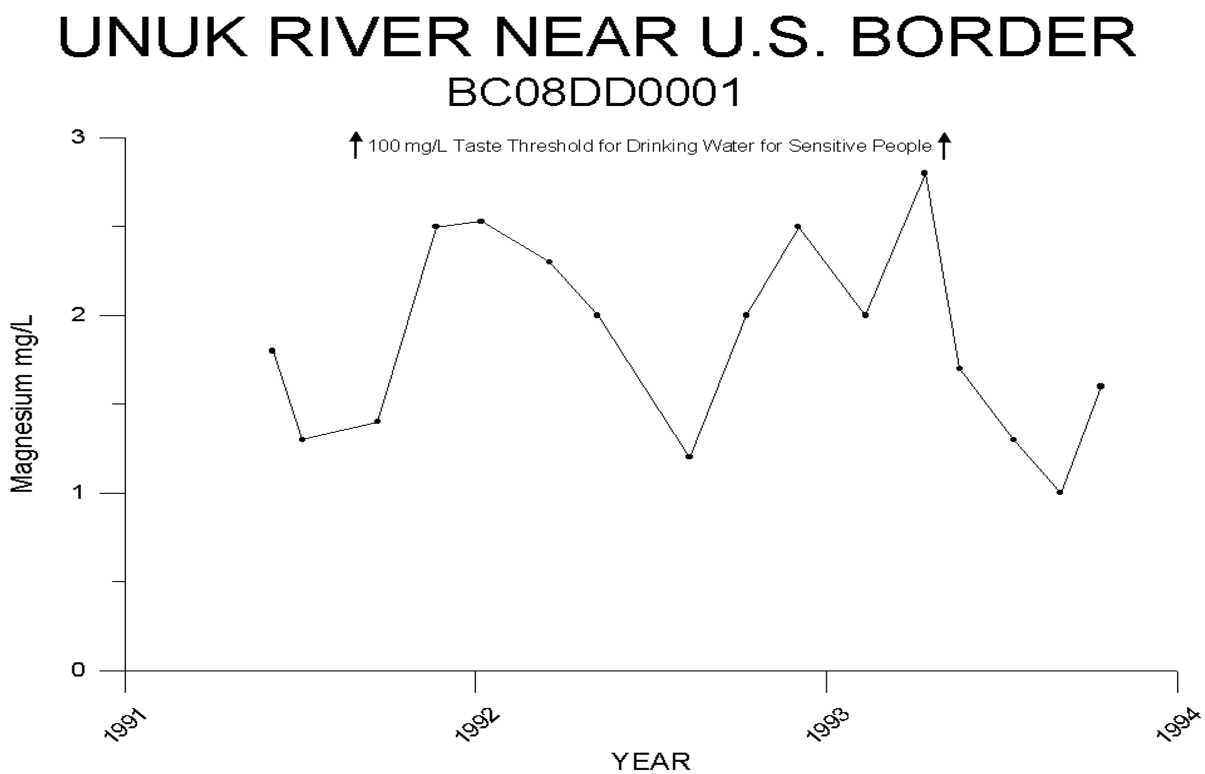


Figure 25 Total Manganese

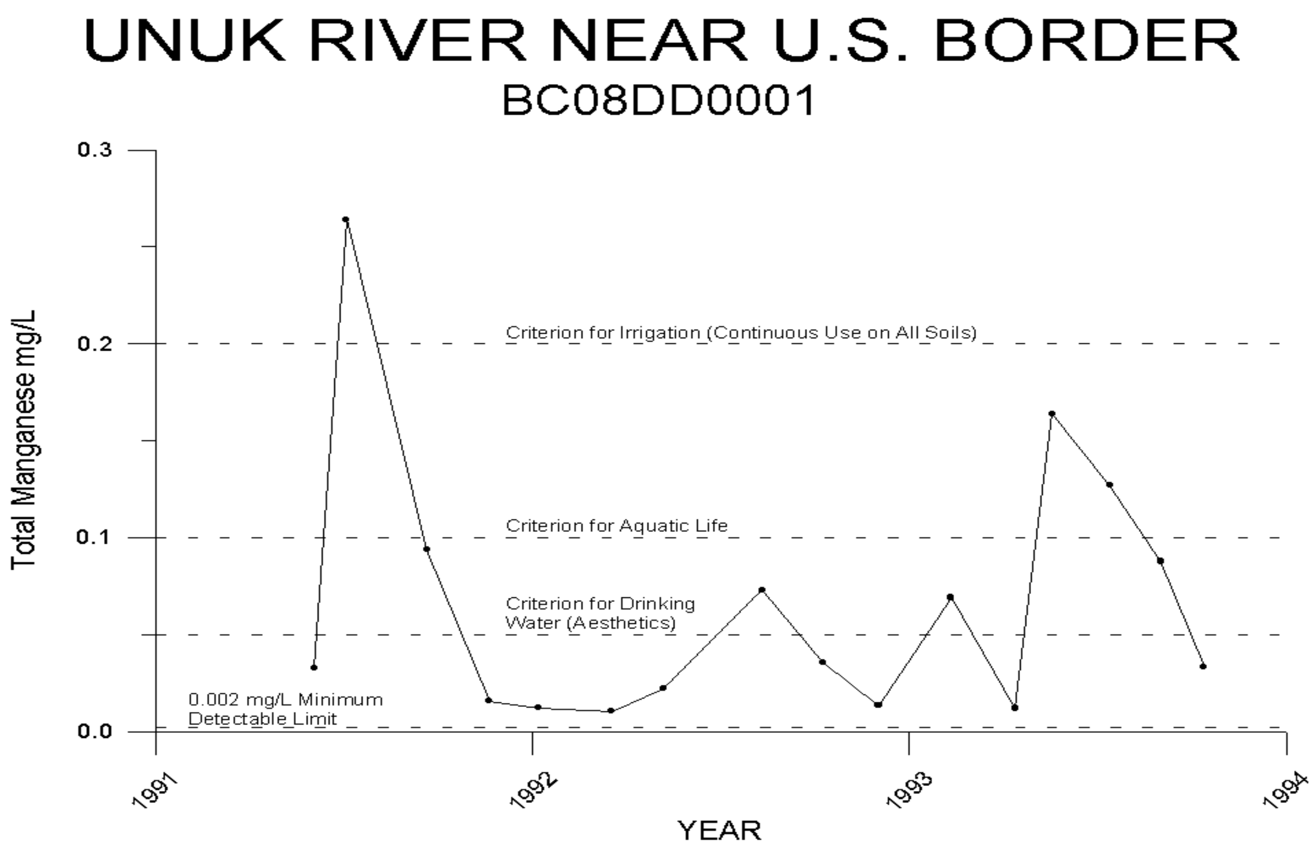


Figure 26 Total Molybdenum

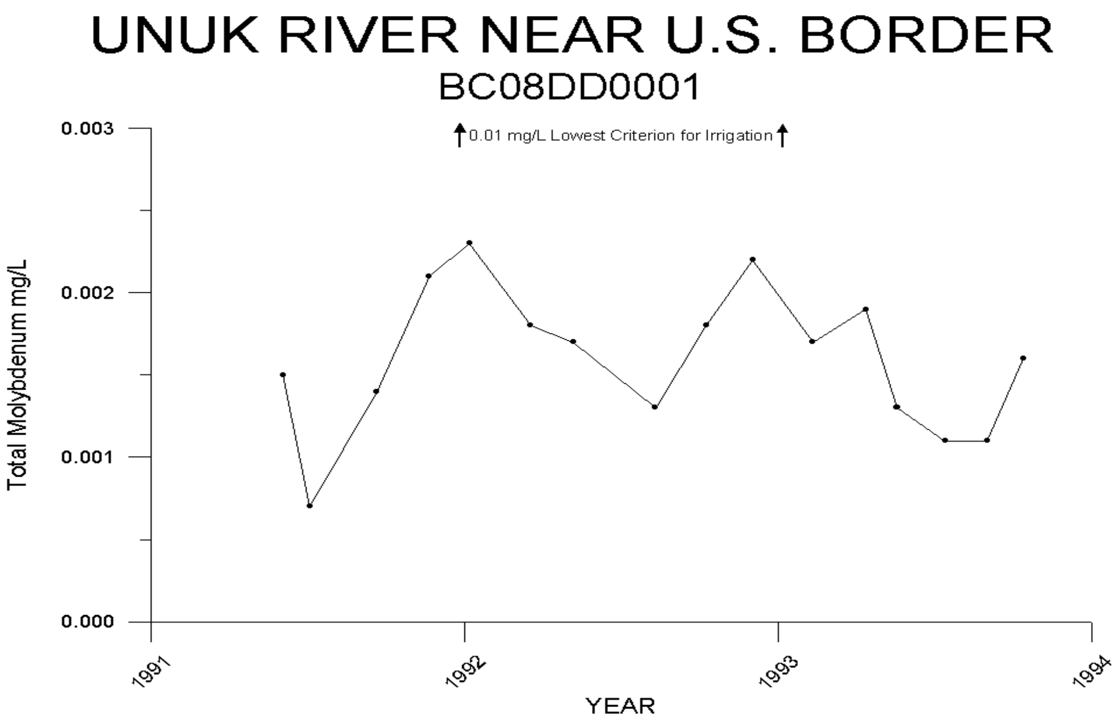


Figure 27 Total Nickel

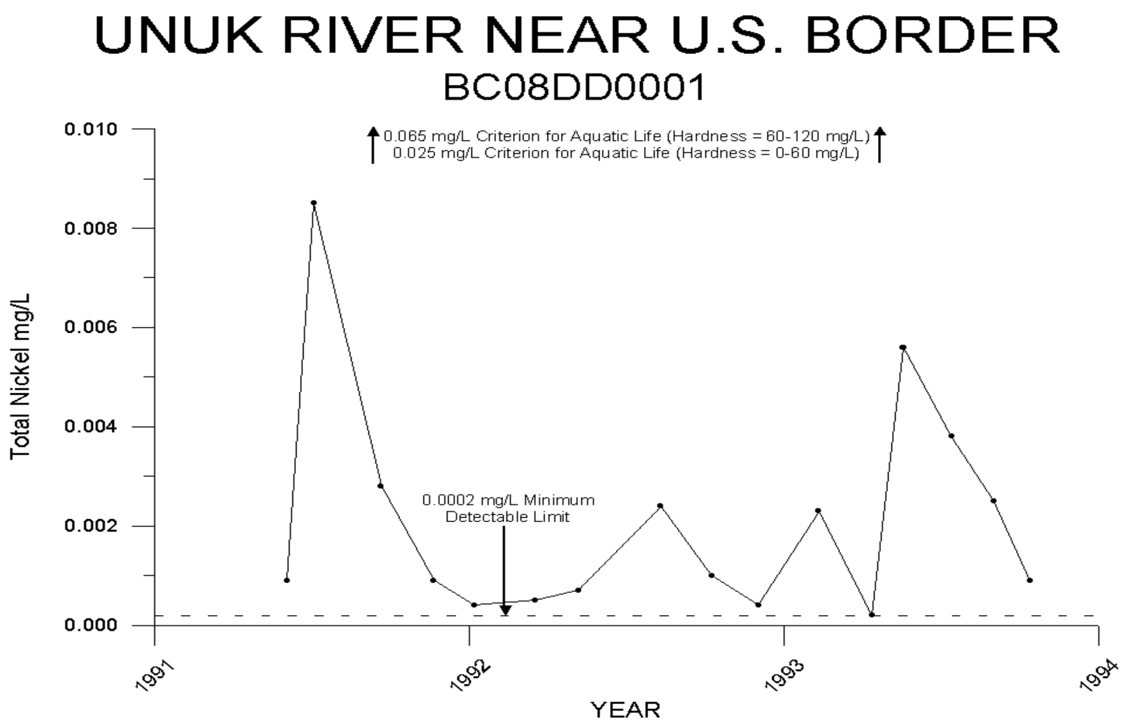


Figure 28 Nitrogen (Nitrate/Nitrite)

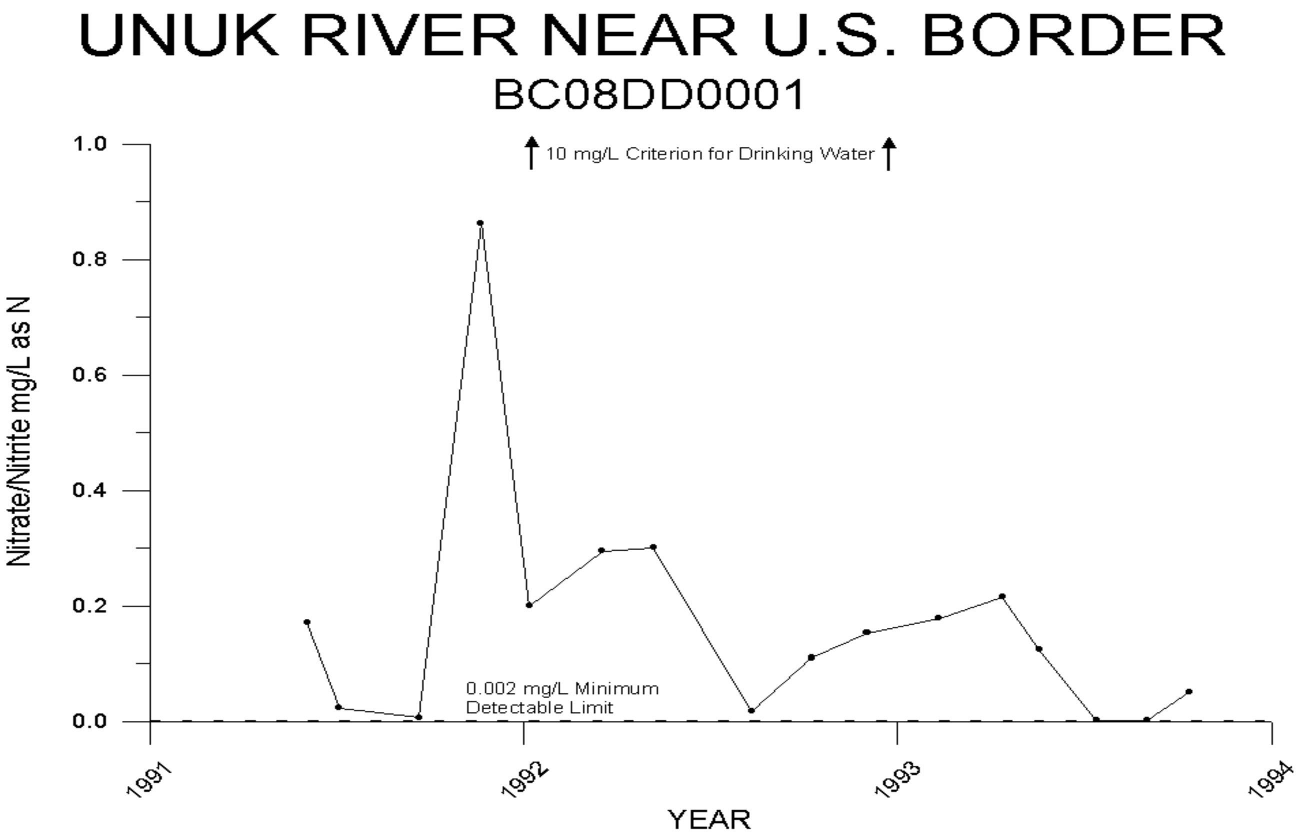


Figure 29 Total Dissolved Nitrogen

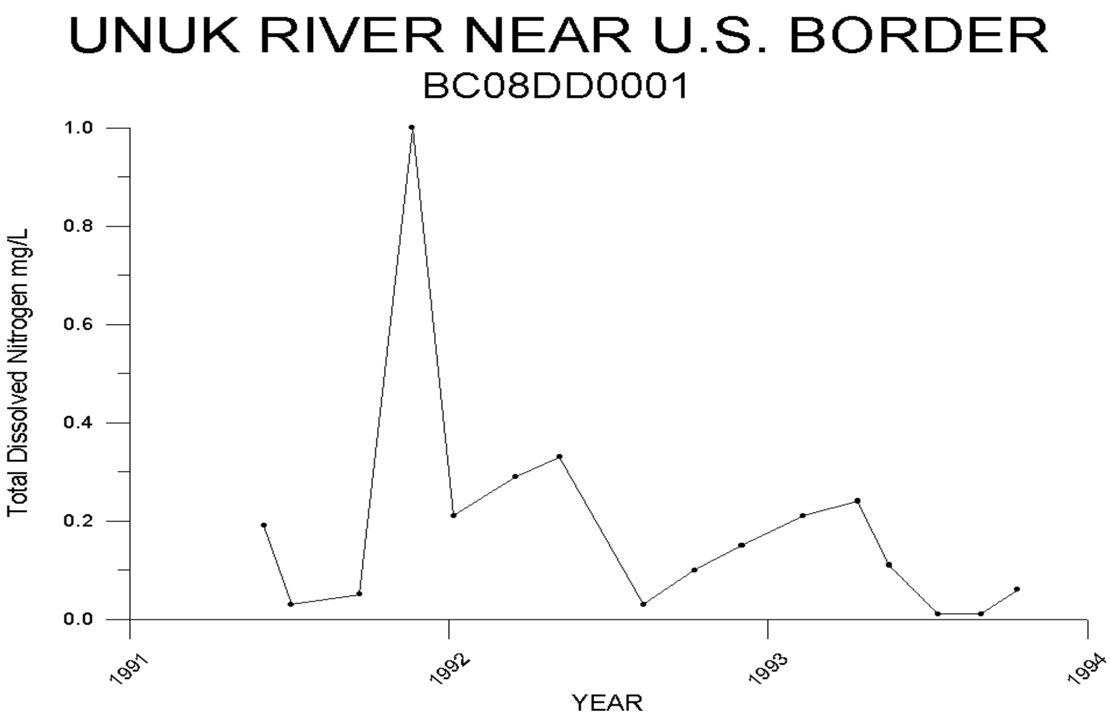


Figure 30 pH

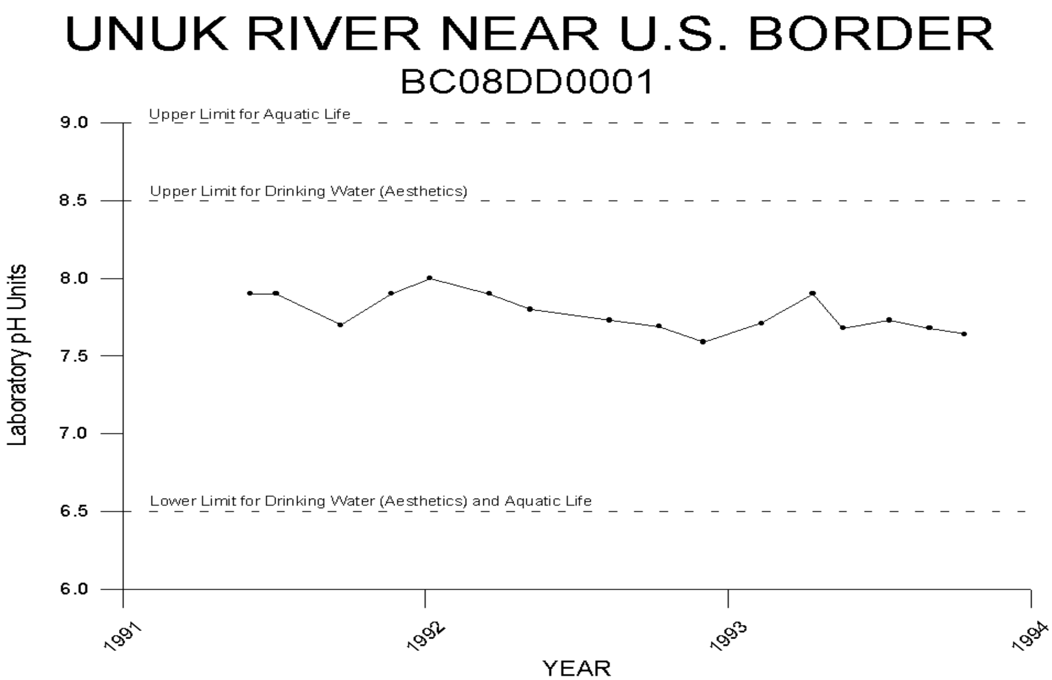

UNUK RIVER NEAR U.S. BORDER
BC08DD0001
Upper Limit for Aquatic Life
Upper Limit for Drinking Water (Aesthetics)
Lower Limit for Drinking Water (Aesthetics) and Aquatic Life
Laboratory pH Units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
1991
1992
1993
1994
YEAR

Figure 31 Total Phosphorus

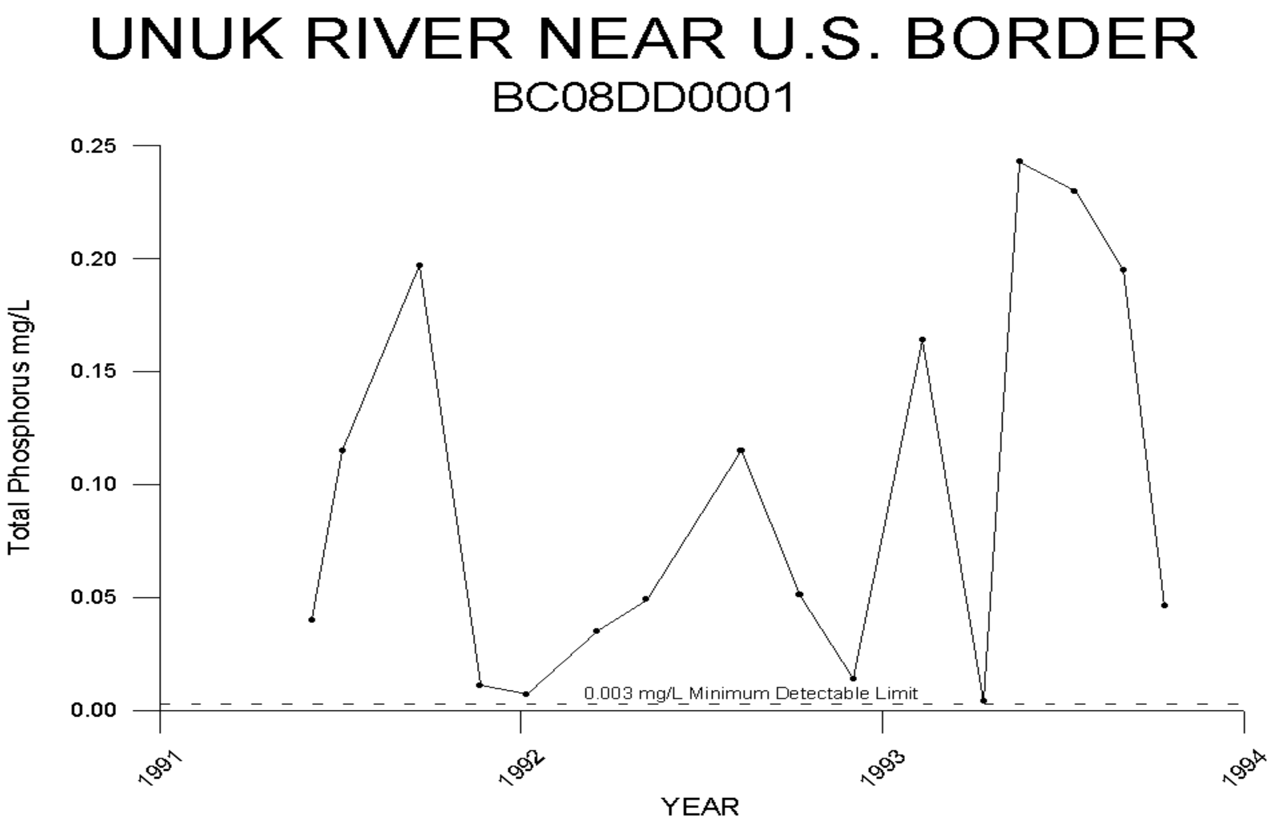


Figure 32 Potassium

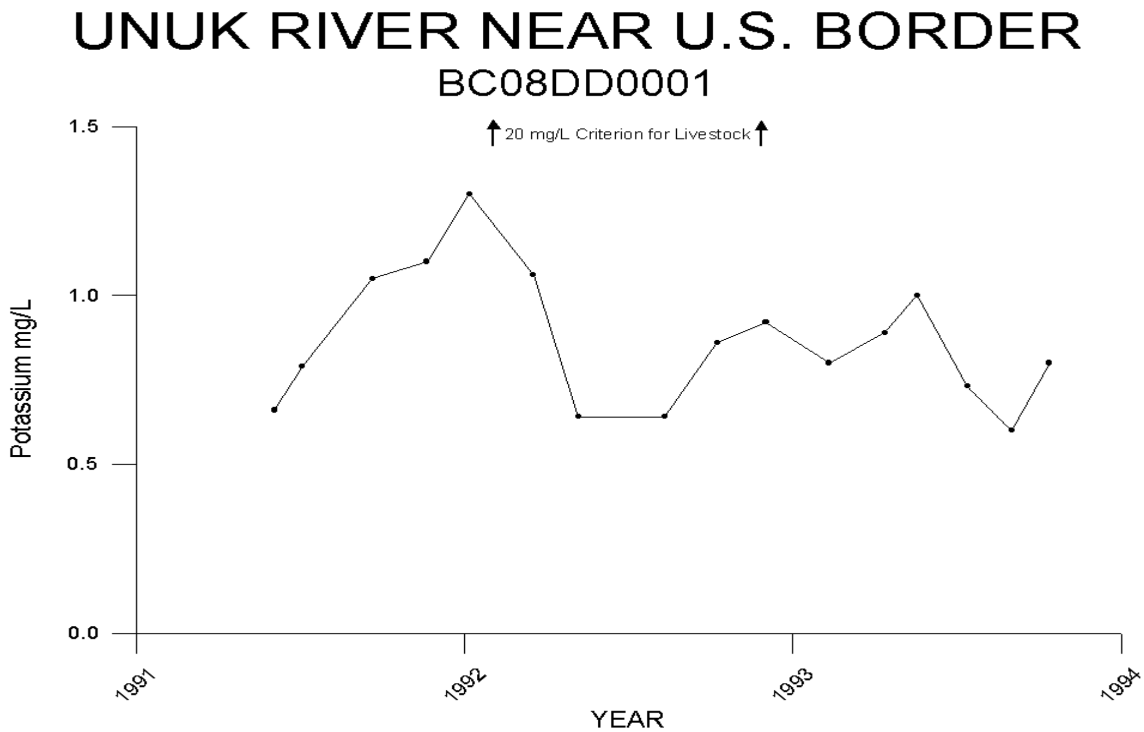


Figure 33 Filterable Residue

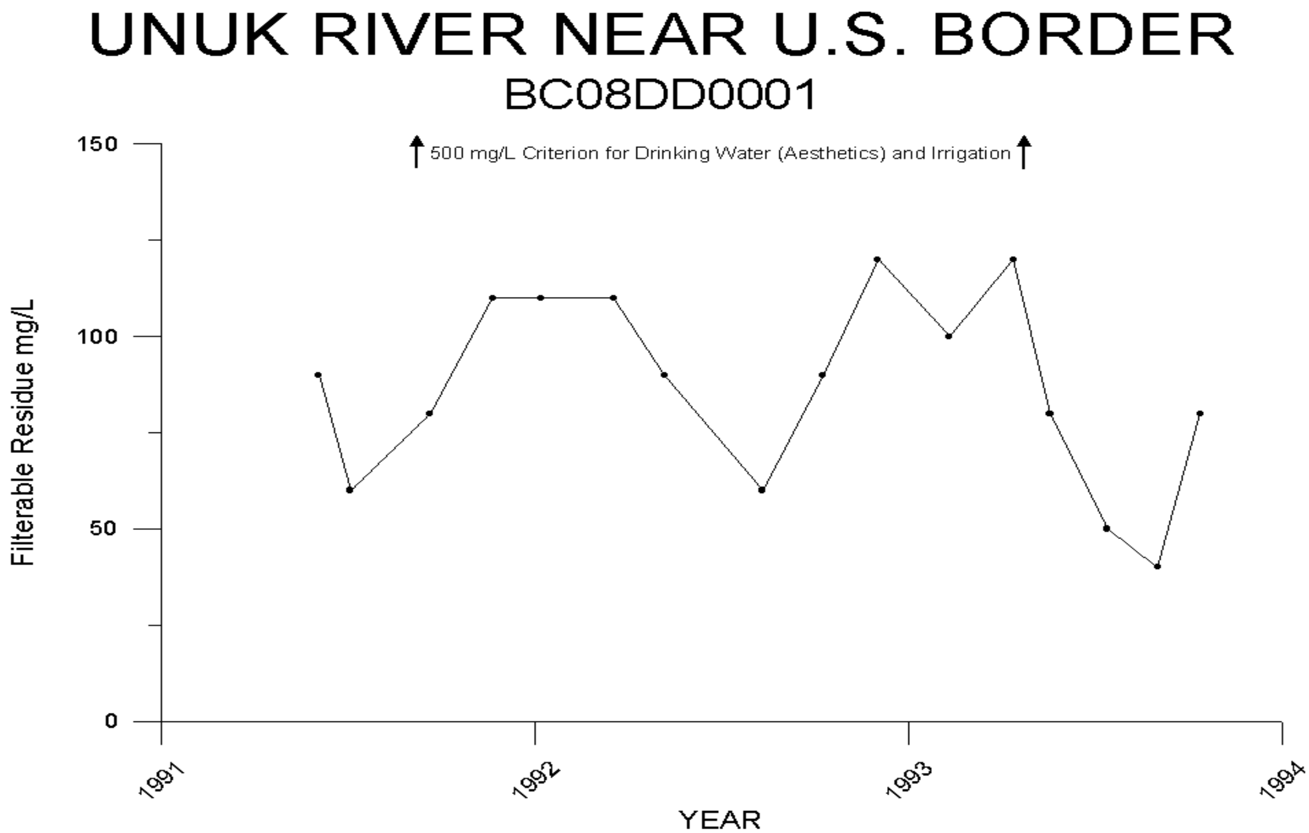


Figure 34 Non-Filterable Residue

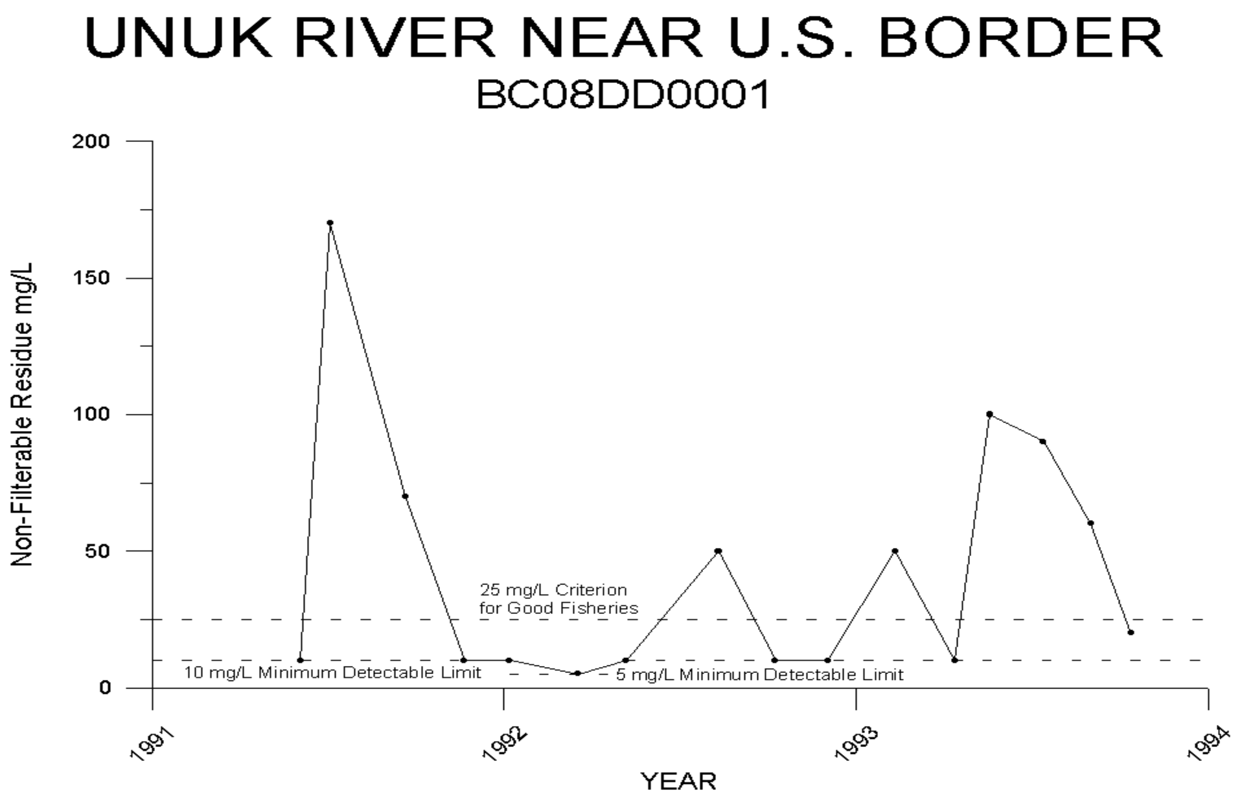


Figure 35 Fixed Filterable Residue

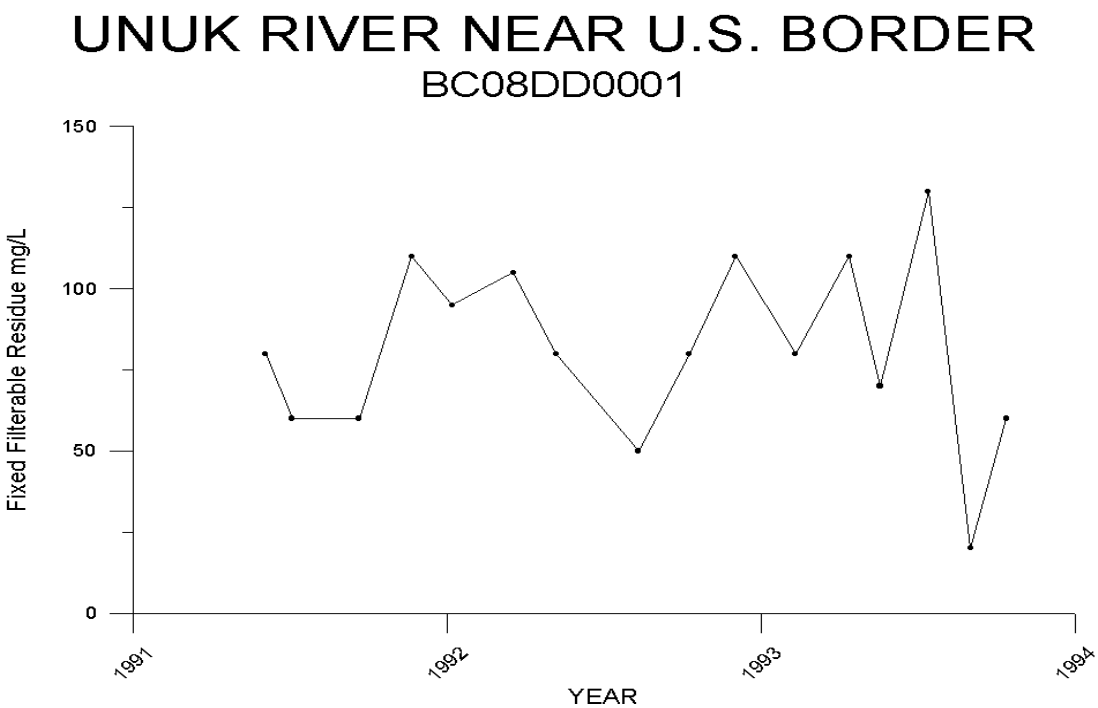


Figure 36 Fixed Non-Filterable Residue

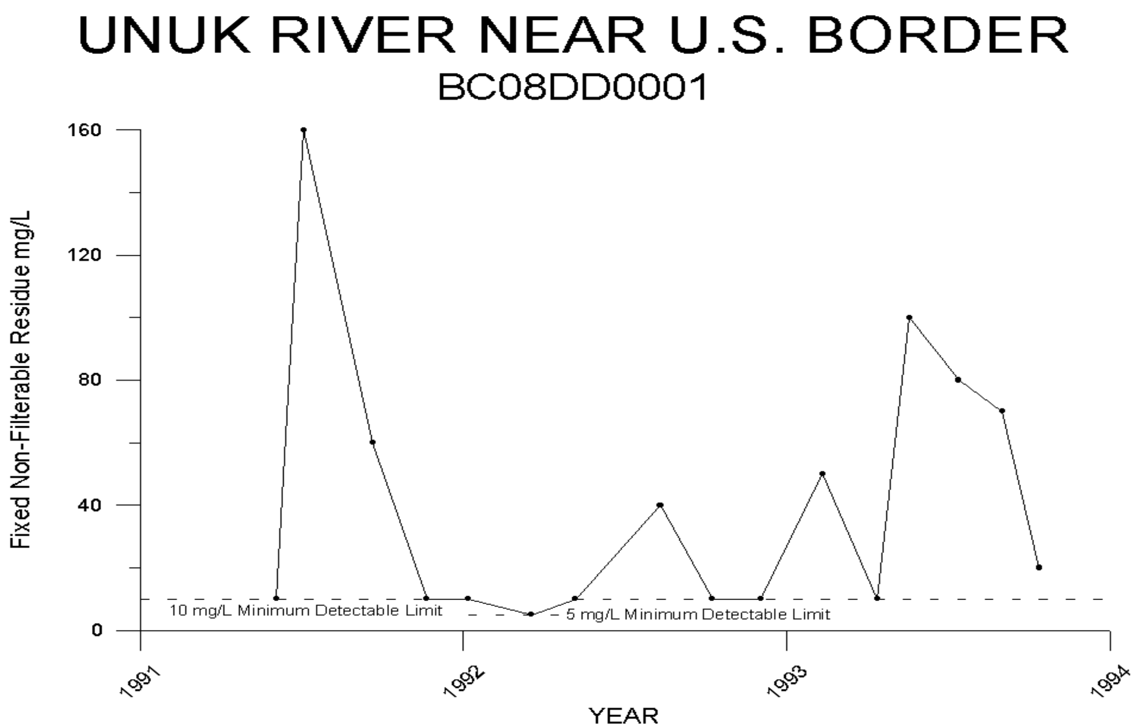


Figure 37 Total Selenium

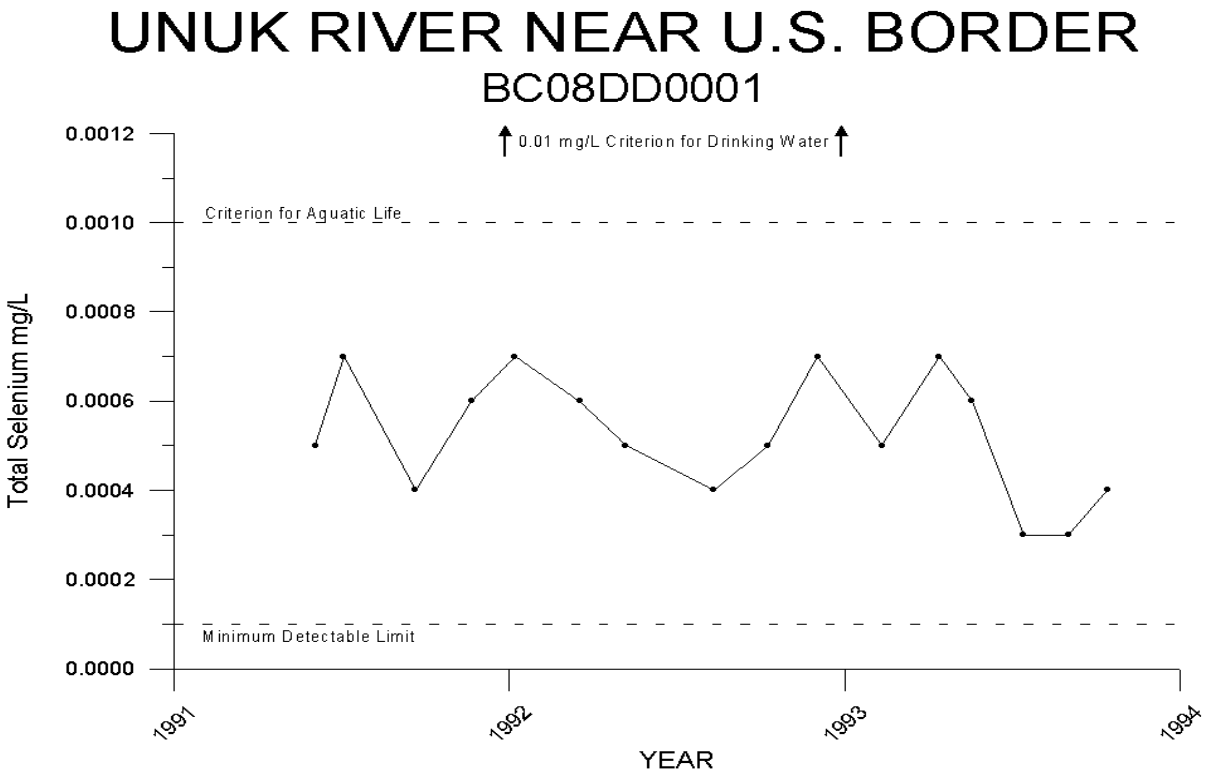


Figure 38 Silica

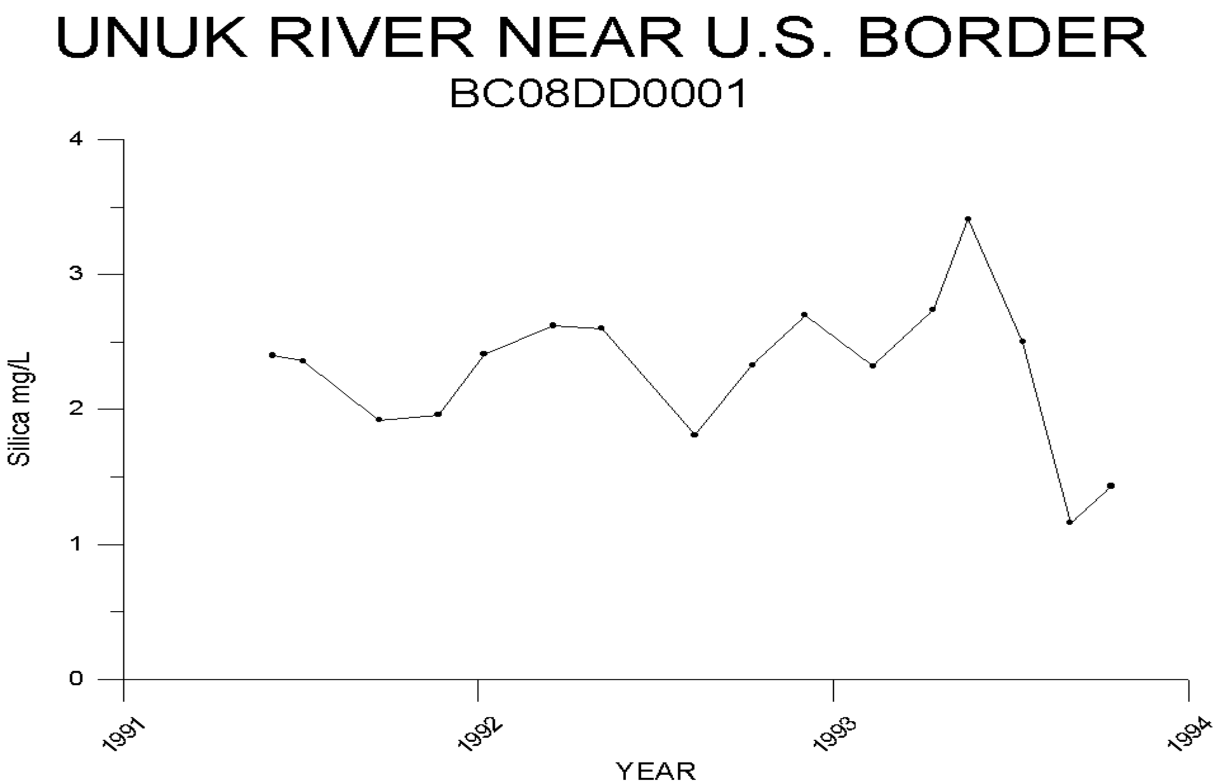


Figure 39 Sodium

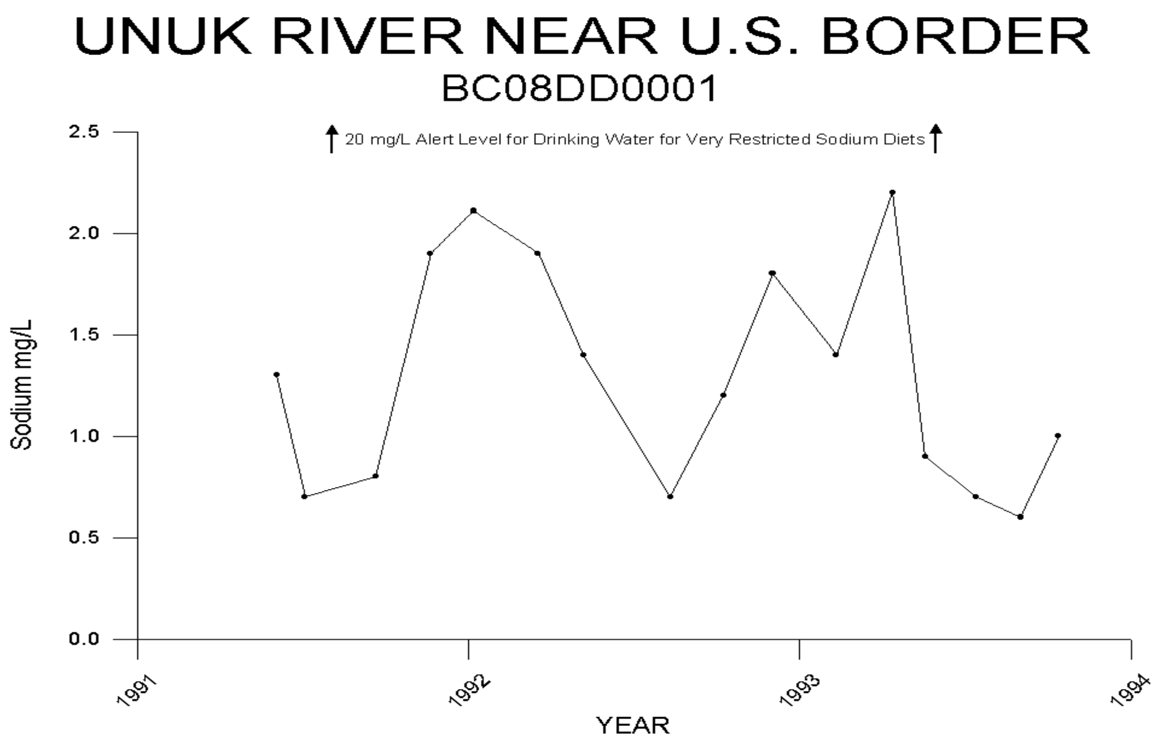


Figure 40 Specific Conductivity

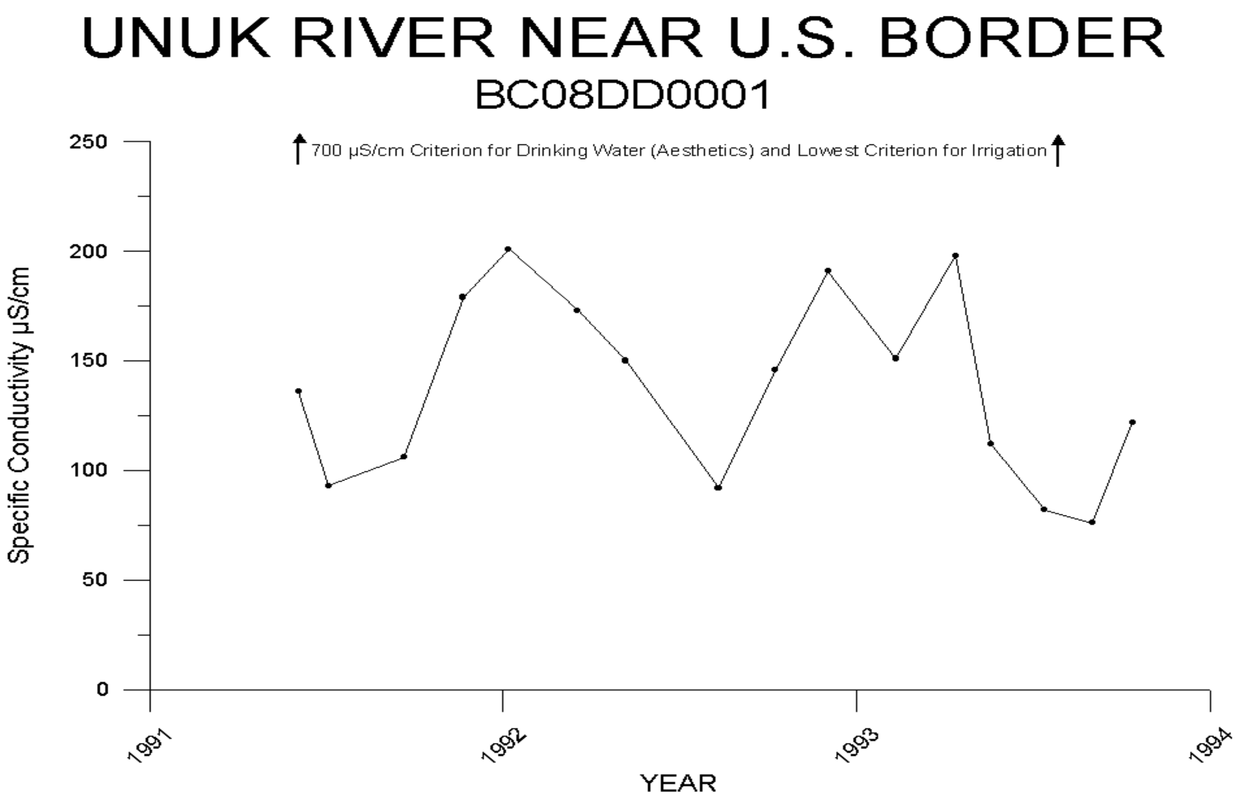


Figure 41 Total Strontium

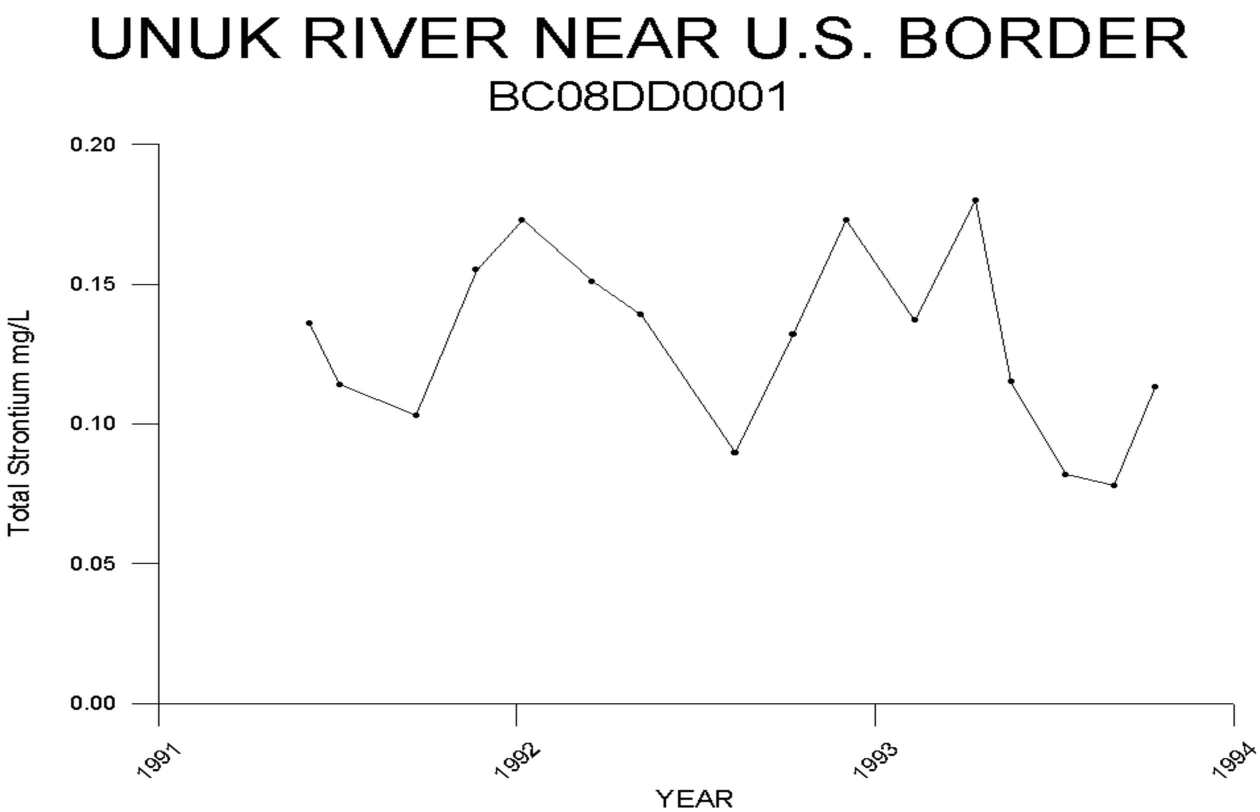


Figure 42 Dissolved Sulphate

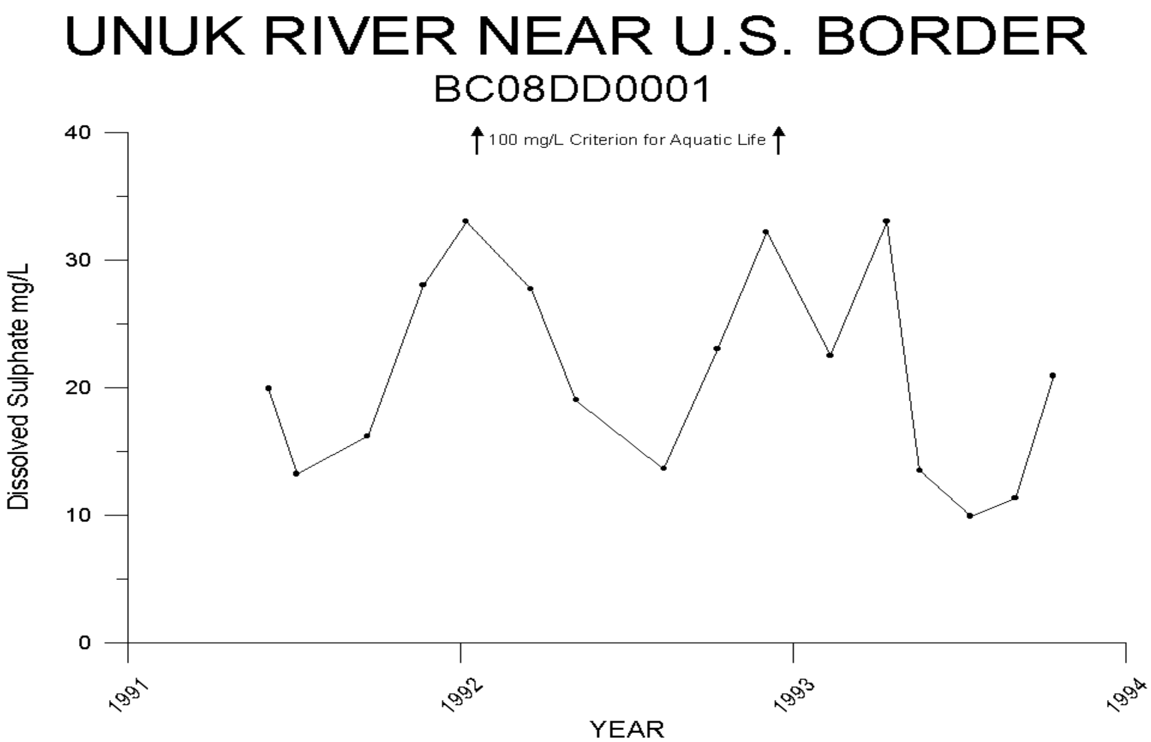


Figure 43 Air Temperature

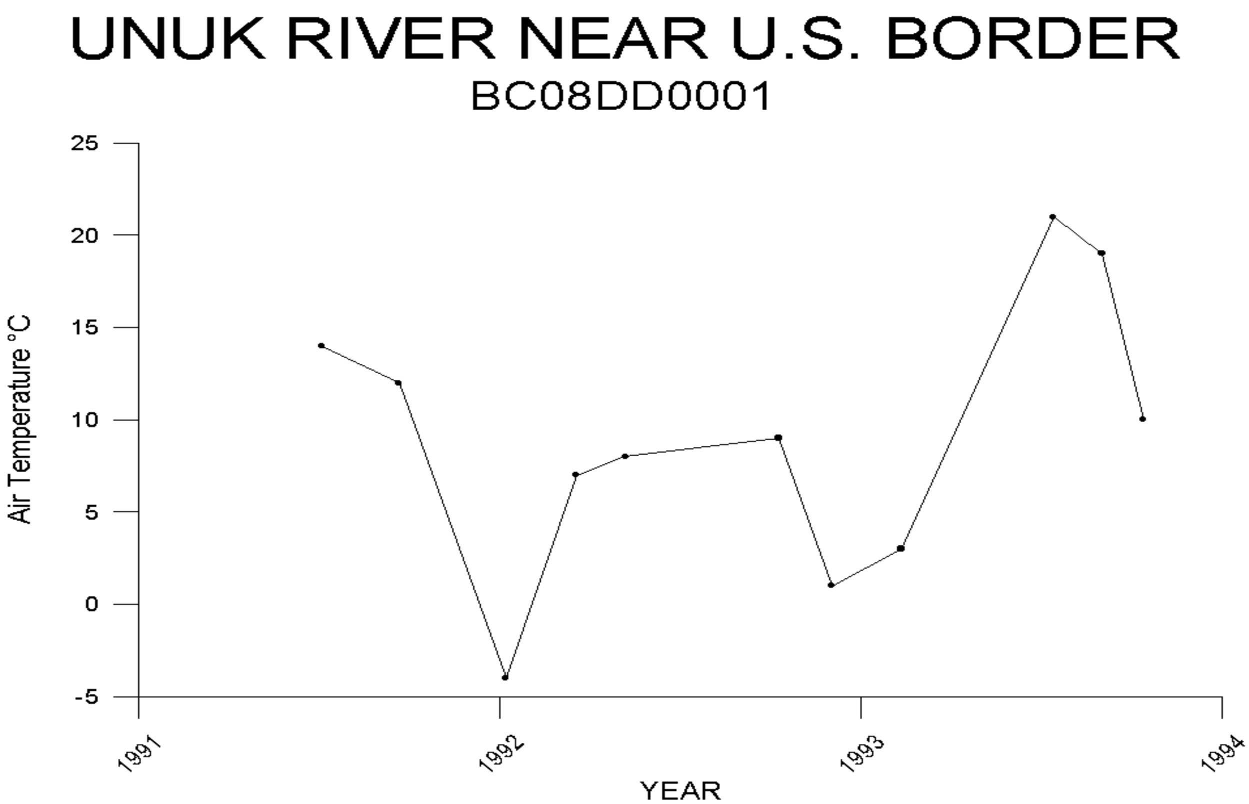


Figure 44 Water Temperature

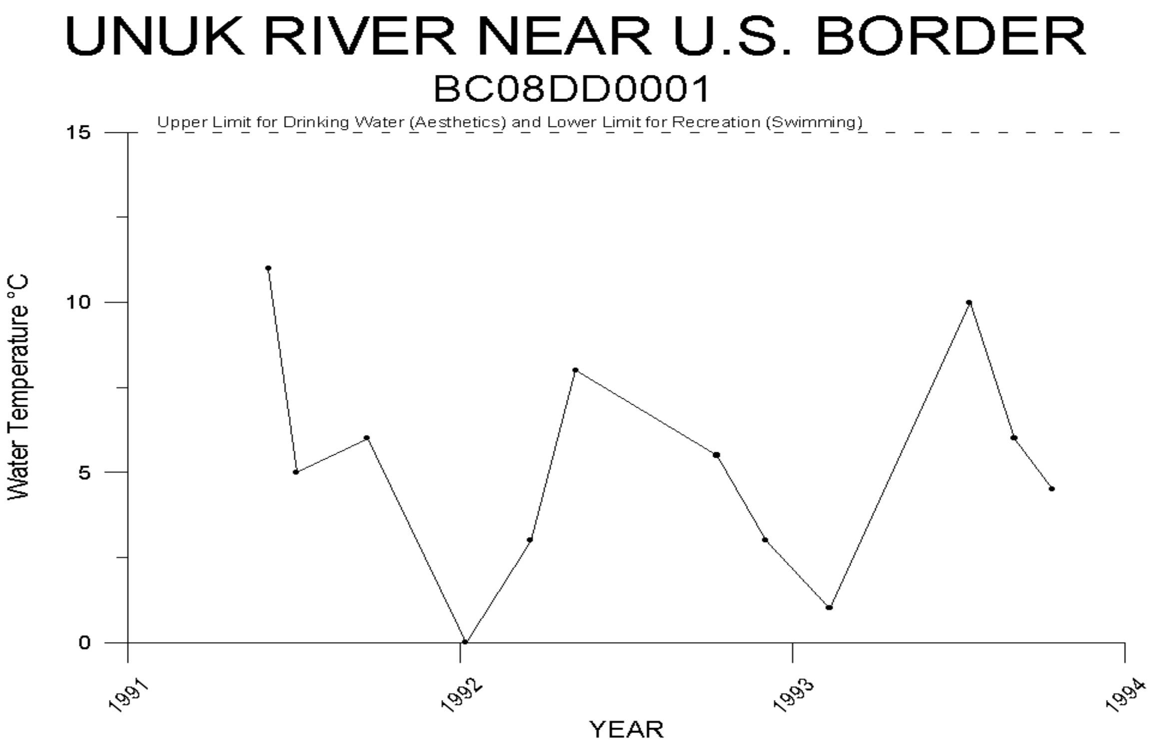


Figure 45 Turbidity

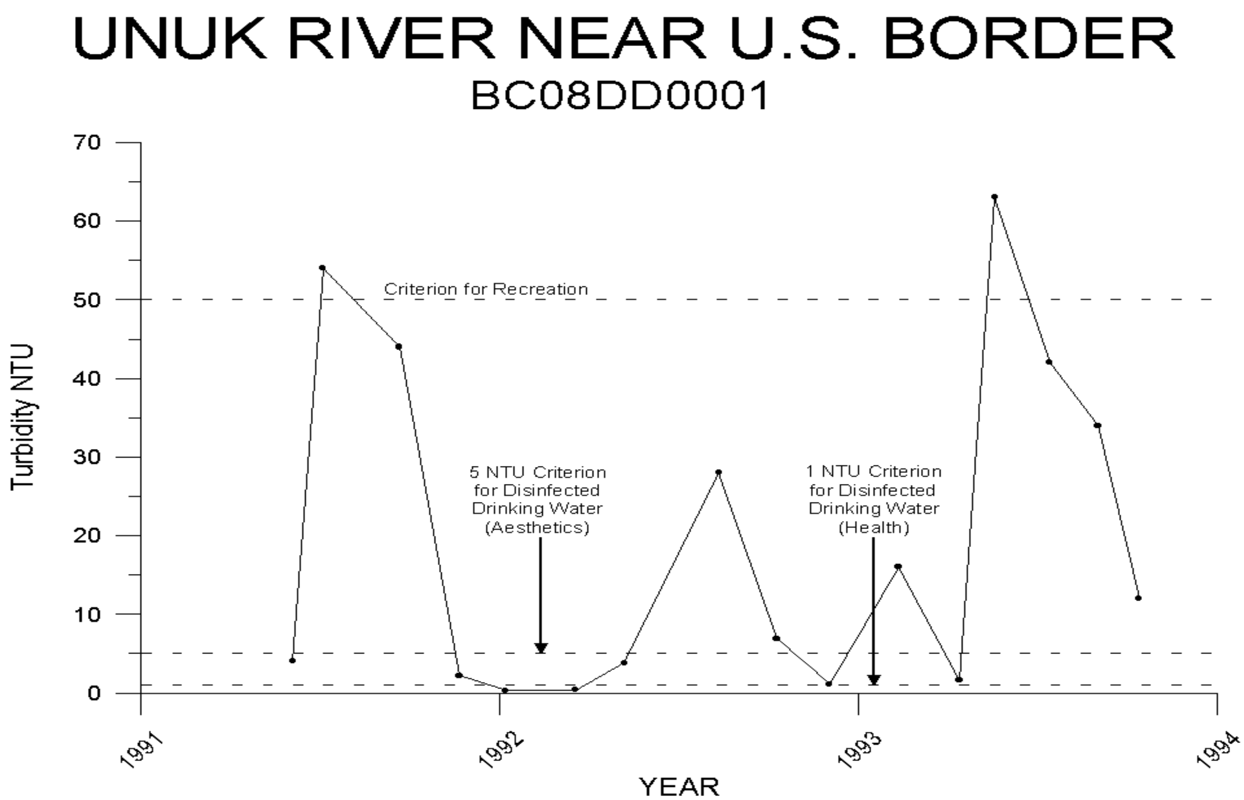


Figure 46 Total Vanadium

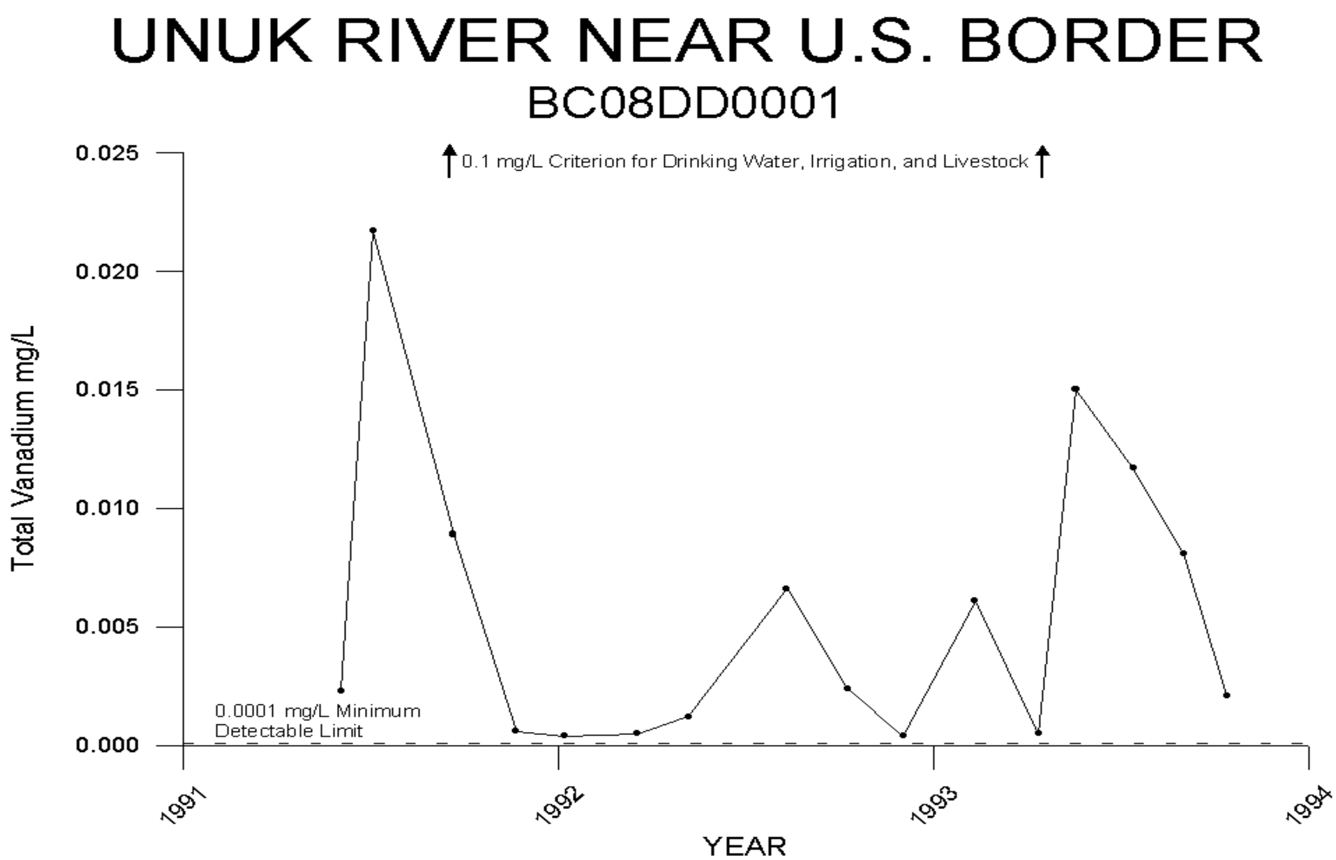
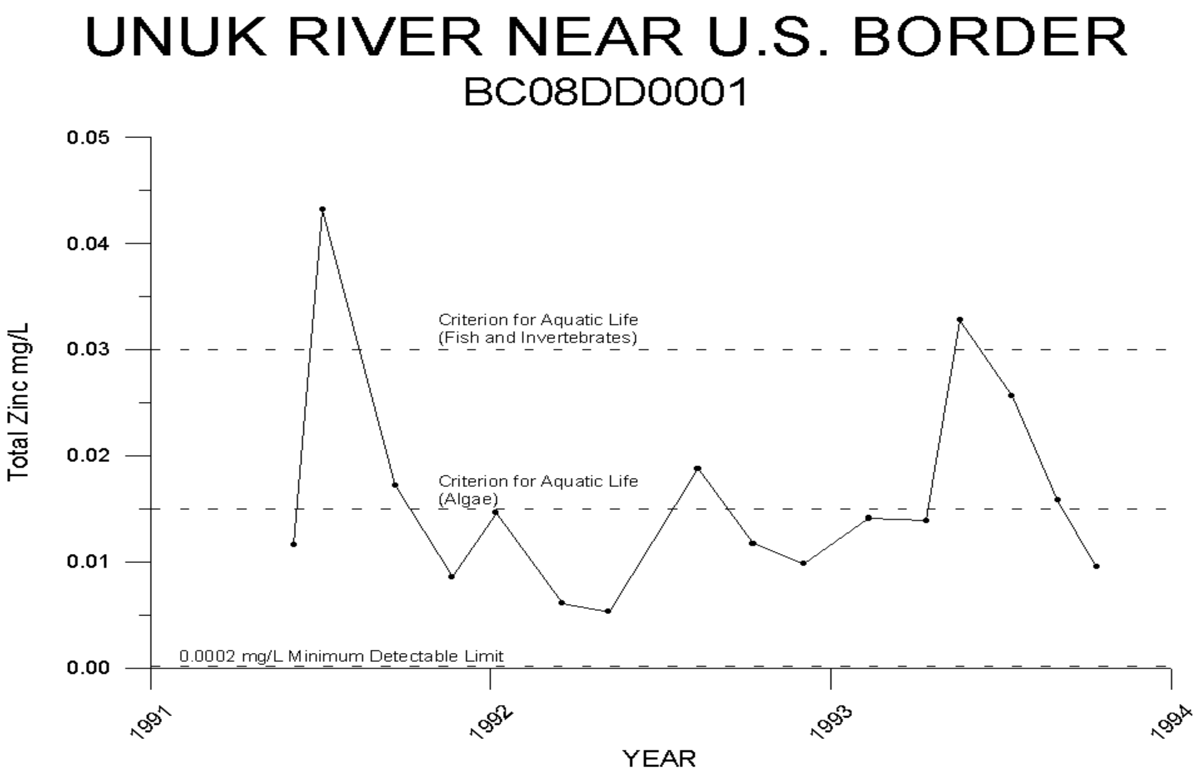


Figure 47 Total Zinc



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