LeRoi S.I. 12

Health Impact Assessment of Metals Detected in Gardens in Northport, Washington

August 1995

Washington State Department of Health

Office of Toxic Substances

Health Impact Assessment of Metals Detected in Gardens in Northport, Washington

August 1995

Washington State Department of Health

For more information or
additional copies of this report contact:

Denise Laflamme
Office of Toxic Substances
PO Box 47825
Airdustrial Center Building 4
Olympia, WA 98504-7825

(360) 753-2410

Page Contents

Page Figure

Page Tables

EXECUTIVE SUMMARY

Purpose of the Study

In response to concerns regarding heavy metal fallout from the Cominco smelter in Trail, B.C. onto home gardens in the Northport area of Washington State, the Washington State Department of Health (DOH) collected soil and crop samples in August 1994 from gardens of three Northport families. The goal of the garden sampling was to get an indication about whether metals in garden soils and vegetables were at levels that could affect the health of families who eat vegetables from their gardens.

Soil and Vegetable Sampling

A total of ten soil samples and 13 vegetable samples were collected from three family gardens in Northport. At least one sample of the following vegetables was collected; carrot, potato, beet, lettuce, beet green, garlic, endive, cabbage, and broccoli. Control samples of vegetables were collected from the Northport grocery store and a family garden in a non-smelter impacted area near Olympia, Washington. Control soil samples were also collected from the family garden near Olympia.

Soil and Vegetable Analytical Results

Soil and crop samples were analyzed for total lead, arsenic, cadmium, and manganese. The concentrations of metals detected in Northport garden soils ranged from 56-113 parts per million (ppm) arsenic, 2.1-2.8 ppm cadmium, 66.5-106 ppm lead, and 336-964 ppm manganese (dry weight). Concentrations of metals in vegetables ranged from less than 0.7-5.2 ppm cadmium, less than 0.7-1.0 ppm lead, and 3.7-290 ppm manganese (dry weight). All arsenic concentrations in vegetables, including the control vegetables, were below the method detection limit of 3.0 ppm.

Comparison of Northport Metals Concentrations to Control Samples

Concentrations of cadmium and lead were higher in Northport soils than in soil samples collected from the control garden. Concentrations of arsenic and manganese in soil in the Northport gardens were comparable to levels measured in the control garden. Concentrations of cadmium and lead were higher in the Northport garden vegetables than in the Northport grocery store vegetables and in vegetables collected from the control garden. Concentrations of manganese in Northport vegetables were similar to levels measured in vegetables from the control garden and from the Northport grocery store.

Comparison of Northport Metals Concentrations to Washington State Background

Arsenic, cadmium, and lead concentrations measured in the Northport garden soils are higher than background soil concentrations of these metals in the state. Manganese concentrations in soil in Northport are similar to state background soil concentrations.

Vegetable Consumption and Potential Health Impacts

The three families who supplied garden samples completed a dietary survey on the amount of vegetables they eat from their gardens. Survey results showed that individuals ate between one and a half to three cups of vegetables per day from their gardens during the growing season. Estimates of daily intakes of the four metals were derived based on the results of the dietary survey and the vegetable metals analysis.

Daily metal intakes were compared to recommended daily intake values determined by the U.S. Environmental Protection Agency (EPA) and DOH, which are set at levels to be protective of health. The results of this comparison showed that the concentrations of lead and manganese measured in Northport garden vegetables were less than the health protective levels determined by EPA. Therefore, the concentrations of lead and manganese in garden vegetables do not appear to be high enough to be toxic to people who consume homegrown garden vegetables at or below the amounts consumed by these families.

The concentrations of cadmium measured in garden vegetables were less than or equal to EPA's and DOH's health protective levels. Therefore, the concentrations of cadmium in garden vegetables do not appear to be high enough to be of concern, however, there is very little margin of safety. Since the detection limits used to analyze arsenic levels in vegetables were not low enough to detect any arsenic, no conclusions could be drawn about potential health impacts from eating garden vegetables due to arsenic. Because vegetables do not readily accumulate arsenic, it is expected that the levels of arsenic in vegetables are substantially lower than the 3 ppm detection limit used in the analysis, but it is not known by how much.

Uncertainties

There are several limitations of this study which should be considered when interpreting the results in this report. First, the number of samples collected was small. This raises questions about how representative these concentrations are of the gardens sampled and of the gardens in the Northport area in general. Second, metals differ in their bioavailability and toxicity by their compound form or speciation. Since samples were analyzed for total metals, no information on the form or species of the metals was provided which would aid in making health interpretations of the data. Third, since arsenic was not detected in any of the vegetable samples due to the laboratory method detection limit used, concentrations of arsenic in vegetables are still unknown. Although, several estimates and assumptions were made in interpreting the health significance of these garden data, many estimates and assumptions were protective and most likely overestimate the extent of exposure from eating these vegetables.

Preventive Measures

For people who want to reduce their exposure to metals in homegrown vegetables, there are preventive measures that can be taken to reduce intake of metals from eating garden vegetables. These measures are: (1) add lime, which decreases the uptake of some metals in vegetables; (2) avoid using phosphate fertilizers; (3) avoid using compost derived from sewage sludge as these can be sources of additional arsenic and cadmium; (4) use uncontaminated topsoil in gardens; and (5) wash all vegetables before eating or canning in order to remove metal dusts and other contaminants which may have settled on the plant surface.

INTRODUCTION

The Cominco Ltd. smelter in Trail, B.C. Canada is a primary lead zinc smelter and has been in operation since the turn of the century. In 1993 and 1994, the Washington State Department of Ecology (Ecology) conducted an air monitoring study of heavy metals in the Northport Washington area (*Summary of Activities - Air Monitoring Data and Evaluation of Health Concerns in Areas of Northeast Tri-County*, DOH, April 1994). This study specifically addressed the impact of air emissions from the Cominco smelter on air quality of the area around Northport Washington (see Figure 1). This study concluded that the "quantities of lead, arsenic, and cadmium...suggest that a smelting process is the likely source of these metals." DOH also analyzed Ecology's monitoring data and concluded that the levels of cadmium, arsenic, and lead measured in the ambient air were a possible health concern requiring additional analysis.

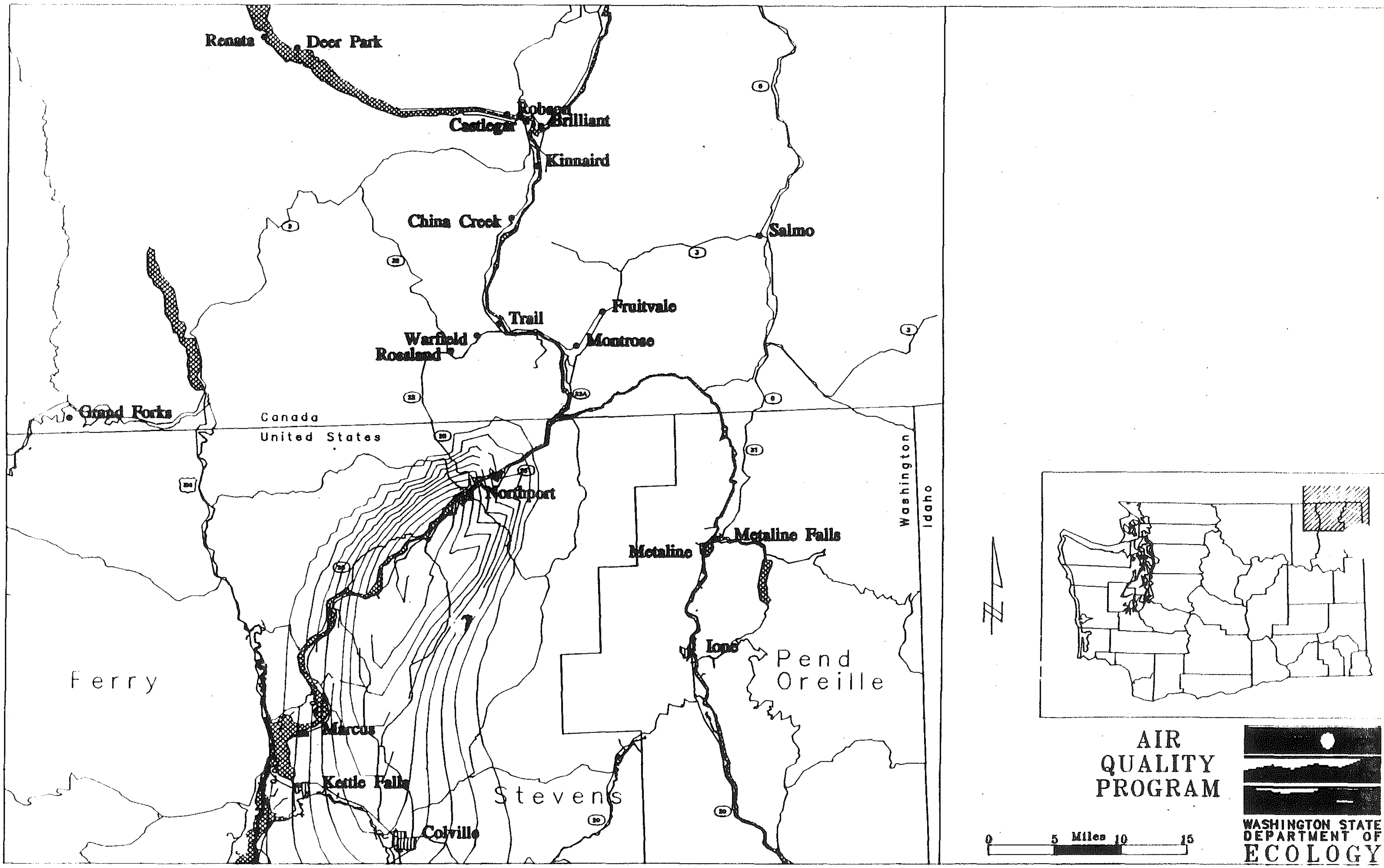
In addition to Cominco's ongoing environmental impact on Northport, there are other sources of heavy metals in the area. From 1897 until 1922, the Northport smelter, which was named the LeRoi Company smelter until 1901, operated sporadically, processing copper, lead, silver, and zinc ores from mines in northeastern Washington (DNR, 1982). Currently, a lumber mill is located on the property of the former Northport smelter. In 1993, EPA performed a site inspection of the former Northport smelter area evaluating it as a possible Superfund hazardous waste site (EPA, 1993). EPA's site inspection revealed on-site soil metal contamination. Based on a low probability of migration of site contaminants, however, EPA concluded that the site would not be further evaluated under the Superfund program.

The Van Stone Mine, near Onion Creek, is the only known operating lead and zinc mine in the Northport area. This mine operates intermittently and the milled ore is reported to be sent to the Cominco smelter in Trail, B.C. Additionally, manganese has also been of concern to residents, specifically in the Kettle Falls area, following reports of elevated levels of manganese in a well and in blood and urine samples of workers at one facility. Several potential sources of environmental exposure to manganese have been preliminarily identified including well water, soil, and dust and occupational exposure to ash (DOH, April 1994).

Many Northport area residents have home gardens and consume their crops. Current and historical discharges of heavy metals to the environment from Cominco and other sources have prompted concern from the Northport community regarding heavy metal fallout onto crops and soils.

An analysis of heavy metals in garden vegetables was recommended by DOH as a follow-up to Ecology's air monitoring study (DOH, April 1994). In response, DOH collected soil and crop samples in August 1994 from the gardens of three families reported to have had or who are currently suffering from adverse health effects. While the cause of reported illnesses in the Northport area (e.g., inflammatory bowel disease) are not known, some of the metals of concern have been associated with gastrointestinal symptoms when workers

Figure 1. Map of Study Area



were exposed to them at high levels. The goal of the garden sampling was to determine whether the concentrations of lead, arsenic, cadmium, and manganese in Northport gardens were at levels that could affect the health of people who eat vegetables from their gardens.

This report summarizes the methods used to collect and analyze the garden soil and crop samples and presents the results of the analysis. An evaluation of the potential health hazard associated with eating these vegetables is also presented.

METHODS

A. Selection of Gardens for Sampling

Dave McBride from DOH pre-arranged all of the garden sampling sites with the Northport families and David Nash, also from DOH, collected the samples. Prior to the two scheduled sampling dates, three gardens were selected for sampling based on at least one of the following factors: 1) an air monitor was located nearby, 2) the family requested that their garden be sampled, and 3) there were known health problems of family members. These gardens were chosen with help from members of the community and with consultation from DOH.

On the first scheduled day of sampling, three gardens were sampled; one complete set of samples from a preselected garden, one partial set of samples from a preselected garden, and one partial set of samples from a non-preselected garden. Collecting partial samples was not planned, however, the sampling plan was modified on-site at the request of a community member whose garden was preselected to be sampled and who offered to give up some of their samples so that a non-preselected garden could be sampled. This person requested this unplanned sampling because the family with the non-preselected garden had reported adverse health effects, complained of air pollution, and had a garden that was doing poorly. Since funding was not available for complete sets of samples from all four sites and the third preselected site could not be deleted without prior approval, it was agreed that partial samples would be collected from the two gardens.

On the second day of sampling, the family with the third pre-selected garden was not home during the time David Nash arrived to take samples. Since it was preferred that the samples be collected and delivered to the laboratory within approximately 24 hours, David Nash was unable to reschedule sampling for that garden. Because of the interest in the non-preselected garden sampled the previous day, additional samples were collected from that site.

Control samples were collected from a garden south of Olympia in a non-smelter impacted area, where metal concentrations were expected to be low. Since arsenic, cadmium, lead, and manganese are normally present in small amounts in soils and vegetables, control samples are used to determine if the levels measured in Northport are above these existing levels.

B. Garden Soil and Crop Collection

Garden soil and crop samples were collected from three private gardens in the Northport area during August 1-2, 1994. Soils were generally sampled from a 6 by 6 inch area adjacent to the crops being sampled. Approximately 500 grams of soil were collected in labeled glass jars obtained from DOH, Public Health Laboratories. Surface samples were collected from the top 1 to 2 inches. Subsurface samples were collected from 3 to 6 inches in depth. Duplicate samples of surface and subsurface soils were collected from the gardens of families 1, 3, and 4(control). Single samples of surface and subsurface soils were collected from the garden of family 2. Samples were generally composited from several subsamples. Plastic spoons were used for digging and transferring the samples to the glass containers.

Where possible, several subsamples of each vegetable crop were collected and composited into a single sample. Crop samples were placed in labeled "zip-lock" plastic bags and stored on ice until they were delivered to the laboratory. All sample jars and bags were sealed with a custody seal. Field sample data and a chain of custody sheet were completed for all samples.

C. Laboratory Sample Preparation and Analysis

Garden soil and crop samples were analyzed by DOH, Public Health Laboratory in Seattle for four metals: manganese, lead, arsenic, and cadmium. Laboratory analysis of the samples began on August 3, 1994. Completed laboratory data was received at DOH, Office of Toxic Substances on October 3, 1994.

Crops

Washing and cutting: Crops were washed three times, first with DI water and then rinsed with millipore water three times and cut into tiny pieces using a stainless steel knife.

Drying: Crop samples were oven dried for 10 to 14 days at a temperature of 50°C until weight was constant.

Grinding: Crops were ground after drying using acid washed mortar and pestle, and were transferred to acid rinsed nalgene bottles.

Acid Digestion: Crops were digested in 10 ml of concentrated nitric acid (HNO_3) in acid rinsed test tubes for 12 to 14 hours. Test tubes were set on heating blocks placed on a hot plate with surface temperature of 130 - 150°C. Samples were then transferred to acid rinsed volumetric flasks and diluted to volume with millipore water.

Soil

Mixing and Screening: In order to obtain homogeneity, samples were mixed thoroughly in each bottle. Samples were shaken, turned over several times to assure proper mixing before opening the bottles. Representative portions of the samples were passed through 2 mm plastic screen and every other samples was rinsed with dilute acid.

Drying: Screened samples (about 7 to 10 grams) were placed in acid rinsed drying dishes and were dried overnight at 105°C.

Acid Digestion: Soil samples were digested in acid rinsed test tubes placed in heating blocks and set on a hot plate with surface temperature at 150 - 170°C. Ten ml of HNO_3 was used for each sample. Samples were then transferred to volumetric flasks and diluted to volume with millipore water.

D. Dietary Survey

Dietary surveys were mailed in February to the three families whose gardens were sampled. The purpose of the dietary survey was to collect information on the quantity of vegetables people ate from their gardens. The dietary survey was modified from a standard self-administered nutritional survey, The Health Habits and History Questionnaire, developed by the National Cancer Institute (NCI) (NCI, 1994). A copy of the modified dietary survey sent to the three families is provided in Appendix A. A separate section of the survey was added to specifically collect information regarding consumption of garden vegetables.

A total of six adults, two from each of the three families, completed the surveys and mailed them back to our office.

RESULTS

A. Metal Concentrations in Garden Soil and Crops

The results of the garden soil and crop analysis are presented below in Table 1.

Table 1. Results of garden soil and crop sampling.

	METAL (ppm)			
	Arsenic (As)	Cadmium (Cd)	Lead (Pb)	Manganese (Mn)
SOIL (surface/subsurface)[a]				
Family 1	113/108	2.09/2.24	79.3/80.2	949/964
Family 2	60/56	2.16/1.78	76.9/66.5	389/336
Family 3	76.4/80	2.7/2.7	106/106	794/772
Family 4 (control)[b]	71.4/68.7	<0.5/<0.5	12/12	567/529
CROP (dry weight)				
Family 1[c]				
carrot	<3.0[d]	1.2	<0.7	34.3
potato	<3.0	<0.7	<0.7	7.0
beet	<3.0	<0.7	<0.7	54.2
lettuce	<3.0	5.23	1.0	195
beet green	<3.0	1.82	1.0	290
Family 2[c]				
garlic	<3.0	<0.7	<0.7	3.7
potato	<3.0	<0.7	<0.7	4.1
lettuce	<3.0	1.23	<0.7	18.0
endive	<3.0	1.28	<0.7	26.2
Family 3				
carrot	<3.0	1.0	<0.7	9.2
potato	<3.0	<0.7	<0.7	5.5
cabbage	<3.0	<0.7	<0.7	11.6
broccoli	<3.0	<0.7	<0.7	31.0
Family 4 (control)[c]				
carrot	<3.0	<0.7	<0.7	23.4
potato	<3.0	<0.7	<0.7	124
lettuce	<3.0	<0.7	<0.7	122
beet green	<3.0	<0.7	<0.7	189
Northport Grocery store (control)				
carrot	<3.0	<0.7	<0.7	63.2
cabbage	<3.0	<0.7	<0.7	22.0

[a] Soil concentrations reported for families 1, 3, and 4 are means of two samples for surface and subsurface samples. Soil concentrations reported for family 2 represent a single sample each of surface and subsurface soil.

[b] Control Samples collected from a garden in a non-smelter impacted area near Olympia, Washington.

[c] Families 1, 2 and 4 garden organically.

[d] Values listed following a less than symbol (<) indicate that the value is the detection limit, i.e. <3.0 indicates that the detection limit is 3.0, and the metal was undetected at that detection limit.

B. Vegetable Consumption Reported in Dietary Surveys

The daily consumption of vegetables (in grams) from their home gardens was determined for each person who completed a survey. The daily consumption amounts of vegetables are listed in Table B-1 of Appendix B. Information provided in the surveys showed that individuals ate between one and a half to three cups per day of vegetables from their gardens. The reported consumption of between one and a half to three cups of vegetables per day seemed to be a reasonable estimate of vegetable consumption, and these amounts were used in the subsequent estimates of metal intakes. Additionally, the amounts reported from the Northport dietary surveys are similar to EPA's recommended total vegetable consumption rate of 200 grams/day (about 1 cup) for use in human health risk assessments (EPA, 1989).

In some cases, either serving size or serving frequency were omitted. To estimate total vegetable consumption in these cases, protective assumptions regarding serving size or serving frequency were used. This was done in order to avoid underestimating vegetable consumption for vegetables that people were clearly stating that they ate but for which there was incomplete information reported in the survey.

C. Estimates of Metal Intakes from Garden Vegetables

This section describes how dietary intake of metals are determined from the dietary survey results and the concentrations of metals detected in garden vegetables. Estimated dietary intakes will be compared to health protective intakes of metals.

A simplified example of how vegetable consumption and daily intakes of metals were calculated is provided below:

Serving size (converted to grams)	x	Frequency of eating serving (converted to times/day)	=	Amount veg. per day (grams veg. per day) (Table B-1)
Amount veg. per day (grams veg. per day) (Table B-1)	x	Concentration of metal in veg. (micrograms metal/gram of veg.) (Table B-2)	=	Daily Intake of Metal (micrograms metal/day) Table B-3 and Table 2

Daily intakes of metals estimated for each individual who completed a dietary survey are summarized in the next section in Table 2.

In addition to the simplified calculation presented above, several adjustments were made in order to estimate daily intakes of metals. Since the garden vegetable metal concentrations were reported as dry weight, and the percent water in the sampled vegetables was not determined by the laboratory, the dry weight concentrations were converted to wet weight concentrations. Percent water content for each vegetable sampled was used to make this conversion (Table B-2). Information on percent water content in vegetables was obtained from USDA (USDA, 1984).

Metal concentrations for vegetables that were not sampled, but which individuals reported as eating, were either estimated from similar vegetables that were sampled (e.g., lettuce concentrations were substituted for spinach concentrations) or were estimated from concentrations reported at other sites or reported in the scientific literature. The derivation of these vegetable concentrations are noted in Table B-1. Since some vegetables (beets, beet greens, cabbage, broccoli, and garlic) were collected from only one garden, metals concentrations from these vegetables were used to estimate metals intake from similar vegetables in the two gardens. Additionally, for some vegetables that were sampled from more than one garden, the maximum metal concentration of all gardens sampled for that vegetable was used to estimated metal intakes for all three families.

Serving sizes were reported as cups in the dietary survey. However, in order to compare this with the metal concentration data, which are reported in grams of metal per grams of vegetable, it was necessary to convert serving size into grams.

The total daily intakes of each metal were converted to a dose by dividing the intake (mg metal/day) by a 70 kg (154 pounds) body weight for men and a 60 kg (132 pounds) body weight for women to arrive at an adult dose in units of mg metal/kg body weight/day. Metal intakes were converted to these units of dose in order to be able to compare them to Health-Based values, which are discussed in the next section.

In addition to making some assumptions about body weights in order to estimate doses, other assumptions were also made in deriving the consumption rates for these vegetables, such as assuming that individuals ate from their gardens six months out of the year continuously for 70 years. Any additional assumptions and references used in deriving vegetable consumption rates and doses are listed in the legends of Tables B-1 through B-4.

DISCUSSION

A. Comparison of Metal Intake Estimates to Health-Based Intake Values

- **Health-Based Intake Values for the Cadmium, Lead, Arsenic, and Manganese**

EPA and other agencies develop guidelines of daily intakes of pollutants which are intended to protect against adverse health effects. For carcinogenic effects, EPA develops cancer potency factors which relate daily intakes with a projected upper-bound cancer risk. For non-carcinogenic effects, EPA develops Reference Doses (RfDs), which are defined as estimates of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. In general, RfDs and cancer potency factors are used by EPA to develop cleanup standards at hazardous waste sites and to set environmental quality standards. DOH generally uses these values as screening levels, to determine whether or not exposures need to be further evaluated.

Of the four metals evaluated in this analysis, all of them except lead have Health-Based intake values to use in comparing to dietary intakes from garden vegetable consumption. Additionally, DOH had previously developed a maximum daily intake for cadmium, which was discussed in a previous report (DOH, 1994). In order to evaluate the health significance of the lead garden data, an EPA model was used to predict whether or not consumption of lead contaminated vegetables could result in elevated blood lead levels. The values and methods used to evaluate the health significance of the dietary estimates of daily metal intakes from consumption of garden vegetables are discussed below.

Table 2. Estimated intakes of metals from vegetables compared to available health-based intake values.

Metal	Estimated Intakes from Vegetables	Health-Based Intake Values (reference)
arsenic	NA[1]	0.0003 mg/kg/day (RfD, EPA) 1.75 (mg/kg/day)-1 (oral potency factor, EPA)
cadmium	0.0006-0.001 mg/kg/day	0.001 mg/kg/day (equiv. to 87 ug/day) (RfD for food, EPA) 0.0012 mg/kg/day in total diet from all sources including background (DOH, 1994); 0.0008-0.001 mg/kg/day in diet above background (DOH, see Appendix D)
lead	0.1 ppm in vegetables[2]	IEUBK model yielded blood lead concentrations < 10 ug/dL
manganese	0.01-0.06 mg/kg/day	0.14 mg/kg/day (RfD for food, EPA)

1 Intake of arsenic not estimated due to non-detected arsenic in all vegetable samples (detection limit = 3 ppm).

2 Both 0.1 ppm lead in home-grown vegetables and an ambient air concentration of 1.0 ug/m3 used as input parameters in IEUBK model (EPA, 1994).

Arsenic

EPA has an RfD for inorganic arsenic of 0.0003 mg/kg/day, which is based on studies where skin and vascular effects were observed. Additionally, EPA has classified arsenic as a human carcinogen and has developed a cancer potency factor for ingestion of arsenic based on studies where skin cancer was observed in several populations consuming drinking water with high arsenic concentrations.

Since none of the vegetable samples collected in Northport had arsenic concentrations above the method detection limit of 3 ppm, we know that the concentrations of arsenic in vegetables are below 3 ppm, but we do not know by how much. Because of this, we have not estimated intakes for arsenic due to a lack of detected data. If it was assumed that all garden vegetables contained 3 ppm arsenic and if exposures were estimated based on this assumption, the daily intake would exceed EPA's Health-Based intake values and could be a health concern. However, since arsenic is not readily taken up into vegetables, even in highly contaminated soils, it is expected that the concentrations of arsenic in vegetables are substantially lower than 3 ppm.

Cadmium

EPA has an RfD for cadmium of 0.001 mg cadmium/kg body weight/day from ingestion of food. EPA does not classify cadmium as a carcinogen for exposure through ingestion, although EPA has classified cadmium as a probable human carcinogen via inhalation based on health effects observed in occupational studies (EPA, 1995).

DOH has also developed a daily intake amount of cadmium protective of health effects which was described in a previous report (DOH, 1994). This value is based on protection against kidney damage. DOH's daily intake incorporates exposures from diet, as well as from air exposures (using monitoring data provided by Ecology), and background exposures of cadmium. Using the equations which were provided in Appendix F of the 1994 DOH report, the daily intake was calculated to be 8.7 ug cadmium/day. This is equivalent to 0.00012 mg/kg/day for a 70 kg person. However, this value is expressed as an absorbed dose, accounting for a 10 percent absorption of cadmium from the digestive tract. Adjusting for this, the daily intake (administered dose) for cadmium becomes 0.0012 mg/kg/day. See Appendix D for an expanded description of the methodology used in developing a daily intake amount for cadmium.

Estimated daily intakes of cadmium from consumption of garden vegetables do not exceed DOH daily intake of cadmium of 0.0012 mg/kg/day or EPA's RfD of 0.001 mg/kg/day. Therefore, it is not expected that consumption of garden vegetables at the amounts reported will result in health effects from exposure to cadmium.

Lead

Currently, neither EPA nor other agencies have Health-Based intake values (i.e., an RfD) for lead. Instead, EPA recommends using the Integrated Exposure Uptake Biokinetic (IEUBK) model for lead as a tool for estimating blood lead concentrations from total environmental exposures to lead (EPA, 1994). The IEUBK lead model incorporates exposures from air, diet, drinking water, soil, and dust in its estimation of blood lead levels.

Since the lead model specifically addresses exposure from diet, the IEUBK model, version 0.99d was run using the Northport soil and crop data. The maximum lead concentration measured in garden vegetables in Northport of 0.1 ppm, wet weight, was used in the model run. Additionally, the following values were used in the model: air concentrations of lead measured previously by Ecology of 1.0 ug/m^3 (DOH, 1994), 200 ppm for soil and dust, 15 ug/l drinking water concentration, and 8 hours/day as time spent outdoors.

Using these values for the different environmental media, the lead model predicted blood lead concentrations of less than 10 ug/dl for children ages 6 months to 7 years. This indicates that eating garden vegetables from the Northport area along with additional exposures from air, drinking water, soil, and dust is not expected to exceed the 10 ug/dl blood lead concentration of concern by the Centers for Disease Control and Prevention (CDCP). Since the model focuses on exposures to children, adult exposures can not be evaluated with this model. However, because children are more susceptible to harmful health effects from lead exposures than adults, the results of the model suggest that adults are also not likely to be affected by the garden lead concentrations measured in Northport.

The results of the EPA model run are supported to some degree by work that has been done in the community surrounding the Cominco smelter, in Trail, B.C. The Trail Lead Program has evaluated the impact of eating garden vegetables on the blood lead concentrations in children in that community (Steven Hilts, personal communication, 2/95). In their report titled Exposure Pathways Investigations, they evaluated the effect different environmental and behavioral variables had on measured blood lead concentrations (Trail Lead Program, 1995b). In this study, eating garden produce did not have an affect on the blood lead concentrations (i.e., there was not a statistically significant positive correlation between childhood blood lead and home grown vegetables). Instead, other routes of exposure, such as ingestion of soil, were shown to be related to elevated blood lead levels. The authors mention that the sample size for this analysis was small (N=95) relative to the other environmental data that they evaluated. There may be several explanations for their results. For example, the lead concentrations in garden vegetables may be too low to contribute significantly to blood lead concentrations, or the lead in vegetables is not readily absorbed into the body (i.e., is not bioavailable) or children in the area do not eat many garden vegetables.

Manganese

EPA has an RfD for manganese of 0.14 mg/kg/day from exposure through food (EPA, 1995). The RfD is based on central nervous system effects.

From the daily intakes of manganese presented in Table 2, we can see that the RfD for manganese of 0.14 mg/kg/day is not exceeded for any of the six people who filled out dietary surveys. Therefore, it is not expected that consumption of garden vegetables at the amounts reported will result in health effects from exposure to manganese through this exposure pathway.

- **Summary of Estimated Metal Intakes Compared to Health-Based Intake Values**

Table 2 summarizes the estimated intake of the four metals from vegetables compared to health-based intake values from EPA or DOH. Based on these comparisons, it is unlikely that the levels of cadmium, lead, and manganese detected in vegetables in the Northport gardens represent a health hazard to the people who regularly eat them. Since dietary intakes of arsenic were not determined due to lack of detected data, no conclusion can be drawn for arsenic. Since the number of vegetables sampled was relatively small, it is difficult to determine if the levels that were measured actually are representative of the overall levels in the gardens sampled, or of gardens in the Northport area, in general.

Although, these analyses focused mainly on the evaluation of ingestion of metals from garden vegetables, exposures from multiple routes were addressed to some degree in the toxicity evaluation of cadmium and lead. For cadmium, exposure from air was incorporated into the daily intake value used to compare to the estimated intake from garden vegetables (Appendix D; DOH, 1994). In the case of lead, exposures from air, soil, and dust were accounted for along with exposure from diet (vegetables) in the EPA IEUBK model. This suggests that exposure to these metals through the routes evaluated are within levels which would not be expected to be toxic. However, since there is a limited number of measurements of air as well as of garden soil and vegetables, these data may not be appropriate to use for generalizing to total or yearly exposures.

B. Concentrations of Metals in Soils and Vegetables from Other Locations

The concentrations of metals measured in Northport soils were compared to background concentrations of these metals in the state and to levels of metals measured in soils near the Cominco smelter in Trail, B.C. in order to put the Northport concentrations in perspective. The following sections briefly describe the results of these comparisons. Additional information and data used in making these comparisons are presented in Appendix C.

- **Background Concentrations of Metals in Soils in Washington State**

The concentrations of arsenic, cadmium, lead, and manganese measured in Northport soil were compared to background levels of these metals measured across the state (Ecology, 1994). From the limited number of garden soil samples collected in Northport, it appears that the concentrations of arsenic, cadmium, and lead in Northport garden soil are higher than background soil concentrations of these metals in the rest of the state. Concentrations of manganese in soil in Northport appear to be similar to background soil concentrations in other parts of the state.

- **Concentrations of Metals in Soils in Trail, B.C.**

Lead and cadmium soil concentrations appear to be higher in Trail B. C. than in Northport. Alternatively, arsenic concentrations in soil appear to be similar in Northport and Trail, B.C. Additionally, arsenic concentrations measured in the control garden soils are also similar to those in Northport and Trail, B.C. The source of the arsenic in the control garden is unknown, but soils there appear to be elevated above background as well, when compared to Ecology's data on background concentrations (Ecology, 1994). The concentrations of manganese appears to be comparable between the Northport and Trail, B.C.

C. Metals Uptake into Plants

- **Factors that Affect Metal Uptake into Plants**

The following section summarizes information about metal uptake into plants for the four metals. This information will be used to provide some recommendations for methods on how gardeners can reduce uptake of metals into vegetables.

Arsenic

Arsenic is found in most plants, although its function is not known and it is not an essential nutrient in plants. Highest arsenic concentrations are found in roots and leaves. Mushrooms are especially high arsenic accumulators (Kabata-Pendias and Pendias, 1992). Radishes and lettuce tend to accumulate more arsenic than do carrots and potatoes (Alloway, 1990). Beans and other legumes and onions, spinach and cucumbers are sensitive to arsenic toxicity, exhibiting yellowing or browning of roots, and wilting of new leaves (Kabata-Pendias and Pendias, 1992). Phosphate fertilizers are a potential source of arsenic (Alloway, 1990). In general, arsenic uptake into edible plants is low, even when crops are grown in contaminated soil. Arsenic uptake into plants is lower in plants grown on clay and silt soils than in soils grown on sandy or sandy loam soils (Alloway, 1990). The uptake of arsenic by plants may be increased with increasing pH (increase alkalinity); however, there have been conflicting information on this. The uptake of arsenic into plants depends on the chemical form or species of arsenic, the type of soil and soil characteristics such as pH (Alloway, 1990).

Cadmium

Cadmium is a nonessential element in plants. Cadmium is absorbed by both leaves and roots of vegetables. Cadmium is not well taken up by seed crops. Lettuce, spinach, celery, turnip, and cabbage have been found to accumulate relatively high concentrations of cadmium, but potato, french beans and peas accumulate only small amounts (Kabata-Pendias and Pendias, 1992; Alloway, 1990). Fruits and fruit juices contain low concentrations of cadmium (Sherlock, 1984).

Sewage sludges and phosphate fertilizers are important known sources of cadmium (Kabata-Pendias and Pendias, 1992). Liming and soil organic matter decreases cadmium uptake into plants (MaClean, 1976). Calcium carbonate ($CaCO_3$) in soils can sorb cadmium and reduce its bioavailability. Excess manganese and other metals (Cu, Ni, Se, and P) can also reduce the uptake of cadmium by plants. Liming to pH 7 will reduce bioavailability of cadmium (Alloway, 1990). However, a report on the uptake of cadmium from smelter contaminated soils notes that liming actually increased the uptake of cadmium in some plants (EPA, 1977).

Lead

Lead is naturally occurring in plants; although, it has not been shown to have an essential role in metabolism. Lead is passively taken up by roots from soil. The uptake of lead by plants is reduced by liming and by low temperature. Airborne lead is readily taken up by plants through foliage. The solubility of lead can be greatly decreased by liming. Leafy vegetables grown near nonferrous metal smelters have been reported as having the highest concentrations of lead (Kabata-Pendias and Pendias, 1992).

Manganese

Manganese is an essential plant nutrient and controls the behavior of other micronutrients. Common manganese concentrations in rocks is 350 to 2000 ppm. Liming decreases the bioavailability of manganese. Manganese is taken up by plants when it is in a soluble form in soils. Manganese concentrations in plants is negatively related to increasing soil pH and positively related to soil organic matter. The highest concentrations of manganese in plant foodstuffs are reported for beet roots and the lowest in tree fruits (Kabata-Pendias and Pendias, 1992).

CONCLUSIONS

1. The concentrations of cadmium, lead, and manganese measured in Northport garden vegetables do not appear to be high enough to be toxic to the people who eat homegrown vegetables regularly. This conclusion is based on a relatively small number of soil and garden vegetable samples and may not be a good indication of metal levels throughout the Northport area. Since the detection limits used in analyzing arsenic levels in vegetables were not low enough to detect any arsenic, no conclusions could be drawn about potential health impacts from eating garden vegetables due to arsenic. If further testing of soils and vegetables is conducted, DOH can provide assistance with interpretation of any additional data.

2. The concentrations of arsenic, cadmium, and lead in soil detected in Northport are higher than concentrations found at "background" areas of the state. The soil concentrations in Northport are comparable to other soil concentrations measured near the smelter in Trail, B.C.

3. For people who are concerned about the uptake of metals in homegrown vegetables, there are preventive measures that individuals can take to reduce intake of metals from consuming garden vegetables or from gardening practices. These are:

   - Add lime to garden soil in order to increase the soil pH. Increasing the soil pH has been shown to decrease uptake of some metals into vegetables.

   - Avoid using phosphate fertilizers as these can be sources of additional arsenic and cadmium.

   - Avoid using compost derived from sewage sludge, as this can also be a source of additional arsenic and cadmium.

   - If possible, use topsoil in gardens which contain lower concentrations of these metals, possibly from areas outside Northport.

   - Wash all vegetables before eating or canning in order to remove metal dusts and other contaminants which may have settled on the plant surface. It is unlikely that cooking will affect the concentrations of metals in vegetables, since metals will tend to stay within the vegetables.

   - Wear garden gloves and wash hands after gardening in order to limit exposure to metals from soil.

4. Individuals interested in further testing should check with specific laboratories for testing capabilities, prices, scheduling, and sampling procedures. We have provided a list of laboratories which may be able to do these analyses. Listing of these laboratories is not an endorsement by DOH, but is provided as information. Additionally, these laboratories can also provide information on testing drinking water.

LISTING OF LABORATORIES

Inland Environmental Laboratories
E 16810 Euclid Avenue
Spokane, Washington 99207-4718
Phone: (509) 928-5651
Contact: David Swenson

AAA Superior Lab
16924 South Curtis Road
Cheney, Washington 99004
Phone: (509) 448-1740
Contact: Cheryl J. Blake

Advanced Analytical Services
E 1514 Sprague
Spokane, Washington 99202-3113
Phone: (509) 535-9791
Contact: Walter Mueller

Washington State Department of Health Laboratory
1610 NE 100th Street
Seattle, Washington 98155-7224
Phone: (206) 361-2910
Contact: Pamela Navaja

Appendices

Appendix A

Dietary Survey

NAME ______________________ DATE ______________ 1 3 ______

PERSONAL INFORMATION, HABITS

8 ___

1. When were you born? ____________ 11 ________
   Month Day Year

2. How old are you? ___ years 18 ___

3. Sex: 1 ___ Male 2 ___ Female 20 ___

skip ~~4.~~ Race or ethnic background:
   1 ___ White, not of Hispanic origin 4 ___ American Indian/Alaskan native
   2 ___ Black, not of Hispanic origin 5 ___ Asian
   3 ___ Hispanic 6 ___ Pacific Islander 21 ___

skip ~~5.~~ Please circle the highest grade in school you have completed:
   1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16+ 22 ___

skip ~~6.~~ What is your marital status? 1 ___ Single 3 ___ Widowed
   2 ___ Married 4 ___ Divorced/Separated 24 ___

7. How many times have you moved or changed residences in the last ten years? ___ times 25 ___

8. Have you smoked at least 100 cigarettes in your entire life? 1 ___ No 2 ___ Yes If Yes, → 27 ___

   IF YES: About how old were you when you first started smoking cigarettes fairly regularly?
   ___ years old 28 ___

   On the average of the entire time you smoked, how many cigarettes did you smoke per day?
   ___ cigarettes per day 30 ___

   Do you smoke cigarettes now? 1 ___ No 2 ___ Yes 32 ___
   IF NO: How old were you when you stopped smoking? ___ years old 33 ___
   IF YES: On the average, about how many cigarettes a day do you smoke now? ___ cigarettes 35 ___

9. Have you ever smoked a pipe or cigars regularly? 1 ___ No 2 ___ Yes If Yes, → 37 ___

   IF YES: For how many years? ___ years 38 ___
   About how much? ___ pipes or cigars per ____________ 40 ___
   (day or week)
   1 2

10. During the past year, have you taken any vitamins or minerals?
   1 ___ No 2 ___ Yes, fairly regularly 3 ___ Yes, but not regularly If Yes, → 43 ___

   What do you take fairly regularly? # of PILLS per DAY, WEEK, etc.

   Multiple Vitamins

One-a-day type	___ pills per ______		44	___
Stress-tabs type	___ pills per ______		47	___
Therapeutic, Theragran type	___ pills per ______	How many milligrams or IUs per pill?	50	___
Other Vitamins				
Vitamin A	___ pills per ______ →	___ IU per pill	53	___
Vitamin C	___ pills per ______ →	___ mg per pill	57	___
Vitamin E	___ pills per ______ →	___ IU per pill	61	___
Calcium or dolomite	___ pills per ______ →	___ mg per pill	65	___

   Other (What?) 1 ___ Yeast 2 ___ Selenium 3 ___ Zinc 4 ___ Iron 5 ___ Beta-carotene
   6 ___ Cod liver oil 7 ___ Other ______________________ 69 ___

   Please list the brand of multiple vitamin/mineral you usually take: ______________

-3-

FOR OFFICE USE
(10) mg or IU 1 = 50-100 2 = 200-250 3 = 400-500 4 = 1000 5 = 5000 6 = 10,000 7 = 20,000-25,000 8 = 50,000 9 = Unk.

11. Are you on a special diet? OFFICE USE

1 ___ No 2 ___ Weight loss 3 ___ For medical condition 4 ___ Vegetarian 5 ___ Low salt

6 ___ Low cholesterol 7 ___ Weight gain 70 ___

12. How often do you eat the following foods from *restaurants* or *fast food places?*

RESTAURANT FOOD	1 Almost every day	2 2-4 times a week	3 Once a week	4 1-3 times a month	5 5-10 times a year	6 1-4 times a year	7 Never, or less than once a year	OFFICE USE
Fried chicken								72 ___
Burgers								73 ___
Pizza								74 ___
Chinese food								75 ___
Mexican food								76 ___
Fried fish								77 ___
Other foods								78 ___

13. This section is about your *usual* eating habits. Thinking back over the past year, how often do you usually eat the foods listed on the next page?

C 79 80

First, check (✓) whether your usual serving size is small, medium or large. (A small portion is about one-half the medium serving size shown, or less; a large portion is about one-and-a-half times as much, or more.)

Then, put a *NUMBER* in the most appropriate column to indicate *HOW OFTEN*, on the average, you eat the food. You may eat bananas *twice a week* (put a *2 in the "week"* column). If you never eat the food, check "Rarely/Never." Please DO NOT SKIP foods. And please BE CAREFUL which column you put your answer in. It will make a big difference if you say "Hamburger once a day" when you mean "Hamburger once a week"!

Some items say "in season." Indicate how often you eat these just in the 2-3 month time when that food is in season. (Be careful about overestimating here.)

Please look at the *example* below. This person

1) eats a medium serving of cantaloupe once a week, in season.
2) has ½ grapefruit about twice a month.
3) has a small serving of sweet potatoes about 3 times a year.
4) has a large hamburger or cheeseburger or meat loaf about four times a week.
5) never eats winter squash.

EXAMPLE:

	Medium Serving	Your Serving Size S	M	L	How often? Day	Week	Month	Year	Rarely/Never
Cantaloupe (in season)	¼ medium		✓			1			
Grapefruit	(½)		✓				2		
Sweet potatoes, yams	½ cup	✓						3	
Hamburger, cheeseburger, meat loaf	1 medium					4			
Winter squash, baked squash	½ cup								✓

PLEASE GO TO NEXT PAGE

-4-

FOR OFFICE USE

On the following two pages, code the four characters for each food as follows:

___	___ ___	___
S-1		Da-1
M-2	Times	Wk-2
L-3		Mo-3
NS-9	NS-99	Yr-4
		Nev-5
		NS-9

If respondent places a checkmark in the "How often" columns, do **not** impute "01" once. Instead, code "99" Not Stated. If respondent does not check a portion size, do **not** impute medium, but code "9".

	Medium Serving	Your Serving Size S M L	How often? Day	Week	Month	Year	Rarely/Never	OFFICE USE
FRUITS & JUICES		S M L						
EXAMPLE – Apples, applesauce, pears	(1) or ½ cup	✓ (M)		4				
Apples, applesauce, pears	(1) or ½ cup							11 ____
Bananas	1 medium							15 ____
Peaches, apricots (canned, frozen or dried, whole year)	(1) or ½ cup							19 ____
Peaches, apricots, nectarines (fresh, in season)	1 medium							23 ____
Cantaloupe (in season)	¼ medium							27 ____
Watermelon (in season)	1 slice							31 ____
Strawberries (fresh, in season)	½ cup							35 ____
Oranges	1 medium							39 ____
Orange juice or grapefruit juice	6 oz. glass							43 ____
Grapefruit	(½)							47 ____
Tang, Start breakfast drinks	6 oz. glass							51 ____
Other fruit juices, fortified fruit drinks	6 oz. glass							55 ____
Any other fruit, including berries, fruit cocktail	½ cup							59 ____
VEGETABLES -- GENERAL (all sources)		S M L	Da	Wk	Mo	Yr	Nv	
String beans, green beans	½ cup							63 ____
Peas	½ cup							67 ____
Chili with beans	¾ cup							71 ____
Other beans such as baked beans, pintos, kidney beans, limas	¾ cup							75 ____ D 79 80
Corn	½ cup							11 ____
Winter squash, baked squash	½ cup							15 ____
Tomatoes, tomato juice	(1) or 6 oz.							19 ____
Red chili sauce, taco sauce, salsa picante	2 Tblsp. sauce							23 ____
Broccoli	½ cup							27 ____
Cauliflower or brussel sprouts	½ cup							31 ____
Spinach (raw)	¾ cup							35 ____
Spinach (cooked)	½ cup							39 ____
Mustard greens, turnip greens, collards	½ cup							43 ____
Cole slaw, cabbage, sauerkraut	½ cup							47 ____
Carrots, or mixed vegetables containing carrots	½ cup							51 ____
Green salad	1 med. bowl							55 ____
Salad dressing, mayonnaise (including on sandwiches)	2 Tblsp.							59 ____
French fries and fried potatoes	¾ cup							63 ____
Sweet potatoes, yams	½ cup							67 ____
Other potatoes, including boiled, baked, potato salad	(1) or ½ cup							71 ____
Rice	¾ cup							75 ____ E 79 80
Any other vegetable, including cooked onions, summer squash	½ cup							11 ____
Butter, margarine or other fat on vegetables, potatoes, etc.	2 pats							15 ____
MEAT, FISH, POULTRY & MIXED DISHES		S M L	Da	Wk	Mo	Yr	Nv	
Hamburgers, cheeseburgers, meat loaf	1 medium							19 ____
Beef—steaks, roasts	4 oz.							23 ____
Beef stew or pot pie with carrots, other vegetables	1 cup							27 ____
Liver, including chicken livers	4 oz.							31 ____
Pork, including chops, roasts	2 chops or 4 oz.							35 ____
Fried chicken	2 sm. or 1 lg. piece							39 ____
Chicken or turkey, roasted, stewed or broiled	2 sm. or 1 lg. piece							43 ____
Fried fish or fish sandwich	4 oz. or 1 sand.							47 ____
Tuna fish, tuna salad, tuna casserole	½ cup							51 ____
Shell fish (shrimp, lobster, crab, oysters, etc.)	5 (¼ cup or 3 oz.)							55 ____
Other fish, broiled, baked	4 oz.							59 ____
Spaghetti, lasagna, other pasta with tomato sauce	1 cup							63 ____
Pizza	2 slices							67 ____
Mixed dishes with cheese (such as macaroni and cheese)	1 cup							71 ____

	Medium Serving	Your Serving Size			How often?					OFFICE USE	
LUNCH ITEMS		S	M	L	Day	Week	Month	Year	Rarely/Never		
Liverwurst	2 slices									75	F 79 80
Hot dogs	2 dogs									11	
Ham, lunch meats	2 slices									15	
Vegetable soup, vegetable beef, minestrone, tomato soup	1 med. bowl									19	
Other soups	1 med. bowl									23	
BREADS / SALTY SNACKS / SPREADS		S	M	L	Da	Wk	Mo	Yr	Nv		
Biscuits, muffins, burger rolls (incl. fast foods)	1 med. piece									27	
White bread (including sandwiches), bagels, etc., crackers	2 slices, 3 cracks									31	
Dark bread, including whole wheat, rye, pumpernickel	2 slices									35	
Corn bread, corn muffins, corn tortillas	1 med. piece									39	
Salty snacks (such as chips, popcorn)	2 handfuls									43	
Peanuts, peanut butter	2 Tblsp.									47	
Butter on bread or rolls	2 pats									51	
Margarine on bread or rolls	2 pats									55	
Gravies made with meat drippings, or white sauce	2 Tblsp.									59	
BREAKFAST FOODS		S	M	L	Da	Wk	Mo	Yr	Nv		
High fiber, bran or granola cereals, shredded wheat	1 med. bowl									63	
Highly fortified cereals, such as Product 19, Total, or Most	1 med. bowl									67	
Other cold cereals, such as Corn Flakes, Rice Krispies	1 med. bowl									71	
Cooked cereals	1 med. bowl									75	G 79 80
Sugar added to cereal	2 teaspn.									11	
Eggs — 1 egg = small,	2 eggs = medium									15	
Bacon	2 slices									19	
Sausage	2 patties or links									23	
SWEETS		S	M	L	Da	Wk	Mo	Yr	Nv		
Ice cream	1 scoop									27	
Doughnuts, cookies, cakes, pastry	1 pc. or 3 cookies									31	
Pumpkin pie, sweet potato pie	1 med. slice									35	
Other pies	1 med. slice									39	
Chocolate candy	small bar, 1 oz.									43	
Other candy, jelly, honey, brown sugar	3 pc. or 1 Tblsp.									47	
DAIRY PRODUCTS		S	M	L	Da	Wk	Mo	Yr	Nv		
Cottage cheese	½ cup									51	
Other cheeses and cheese spreads	2 slices or 2 oz.									55	
Flavored yogurt	1 cup									59	
Whole milk and bevs. with whole milk (not incl. on cereal)	8 oz. glass									63	
2% milk and bevs. with 2% milk (not incl. on cereal)	8 oz. glass									67	
Skim milk, 1% milk or buttermilk (not incl. on cereal)	8 oz. glass									71	
BEVERAGES		S	M	L	Da	Wk	Mo	Yr	Nv		
Regular soft drinks	12 oz. can or bottle									75	H 79 80
Diet soft drinks	12 oz. can or bottle									11	
Beer	12 oz. can or bottle									15	
Wine	1 med. glass									19	
Liquor	1 shot									23	
Decaffeinated coffee	1 med. cup									27	
Coffee, not decaffeinated	1 med. cup									31	
Tea (hot or iced)	1 med. cup									35	
Lemon in tea	1 teaspn.									39	
Non-dairy creamer in coffee or tea	1 Tblsp.									43	
Milk in coffee or tea	1 Tblsp.									47	
Cream (real) or Half-and-Half in coffee or tea	1 Tblsp.									51	
Sugar in coffee or tea	2 teaspn.									55	
Artificial sweetener in coffee or tea	1 packet									59	
Glasses of water, not counting in coffee or tea	8 oz. glass									63	

79 80

14. Think about your diet [illegible] the last year and the responses you have [illegible] made on this questionnaire. Are there any foods not mentioned which you ate *at least once a week*, even in small quantities, or ate frequently in a particular season? Consider other meats, breakfast foods, catsup, green chilies or jalapenos, avocado (guacamole), Mexican dishes, Chinese or other ethnic foods, other fruits or vegetables, as well as nutritional supplements (bran, etc.). *Please take a look at the list of foods at the bottom of the page.*

FOOD	Your Serving Size			How Often?		OFFICE USE Code Amounts
	S	M	L	Day	Week	
						11
						17
						23
						29
						35
						41

	1 Seldom/Never	2 Sometimes	3 Often/Always	
15. How often do you eat the skin on chicken?	___	___	___	47 _
How often do you eat the fat on meat?	___	___	___	48 _
How often do you add salt to your food?	___	___	___	49 _
How often do you add pepper to your food?	___	___	___	50 _

16. How often do you use fat or oil in cooking?
For example, in frying eggs, meat or vegetables? ______ times per ______________ (day, week, month) 51 ___

17. What do you *usually* cook with? 1 ___ Don't know or don't cook 2 ___ Soft margarine
3 ___ Stick margarine 4 ___ Butter 5 ___ Oil 6 ___ Lard, fatback, bacon fat 54 __
7 ___ Pam or no oil

18. What kind of fat do you *usually* add to vegetables, potatoes, etc?
1 ___ Don't add fat 2 ___ Soft margarine 3 ___ Stick margarine 4 ___ Butter 56 __
5 ___ Half butter, half margarine 6 ___ Lard, fatback, bacon fat

19. If you eat cold cereal, what kind do you eat most often? ____________________ 58 ___

20. Not counting salad or potatoes, about how many vegetables do you eat per day or per week? ______ (vegetables) per ______ (day, week) 61 ___

21. Not counting juices, how many fruits do you usually eat per day or per week? ______ (fruits) per ______ (day, week) 64 ___

22. Have you gained or lost more than five pounds in the past year? (You may check more than one answer.)
1 ___ No 2 ___ Lost 5-15 lbs. 3 ___ Lost 16-25 lbs. 4 ___ Lost more than 25 lbs. 67 _
5 ___ Gained 5-15 lbs. 6 ___ Gained 16-25 lbs. 7 ___ Gained more than 25 lbs.

68 9 9

DO YOU EAT THESE ONCE A WEEK?

veal, lamb	[illegible]	pancakes, waffles	[illegible]	onions	41	Hi-C	[illegible]
tofu	[illegible]	instant breakfast, metrecal	[illegible]	summer squash	42	cranberry juice cocktail	[illegible]
mixed dish w/meat	[illegible]	pudding	[illegible]	asparagus	43	grapes	[illegible]
mixed dish w/chicken	[illegible]	milkshake	[illegible]	sweet green peppers	44	mangoes	[illegible]
Chinese dishes	[illegible]	other dairy product	[illegible]	sweet red peppers	45	papayas	[illegible]
Mexican dishes	[illegible]	other dessert, sweet	[illegible]	bean sprouts	46	honeydew or cassaba melon	[illegible]
seafood creole	[illegible]	sour cream, dips	[illegible]	avocado, guacamole	47	lemons or lemon juice	[illegible]
refried beans or bean burritos	[illegible]	diet salad dressing	[illegible]	beets	48	nuts and seeds	[illegible]
Polish or Italian sausage	[illegible]	catsup	[illegible]	pineapple or pineapple juice	[illegible]	bran	[illegible]
cream soups	[illegible]	green chilies, jalapenos	[illegible]	prunes or prune juice	[illegible]	other vegetable/fruit	[illegible]
noodles	[illegible]					other not mentioned here	[illegible]

	Medium Serving	Your Serving Size	How often?	OFFICE USE
		S M L	Day Week Month Year Rarely/Never	
~~FRUITS & JUICES~~		S M L		
EXAMPLE – Apples, applesauce, pears	(1) or ½ cup	✓ (M)	4 (Week)	
Apples, applesauce, pears	(1) or ½ cup			11 ______
Bananas	1 medium			15 ______
Peaches, apricots (canned, frozen or dried, whole year)	(1) or ½ cup			19 ______
Peaches, apricots, nectarines (fresh, in season)	1 medium			23 ______
Cantaloupe (in season)	¼ medium			27 ______
Watermelon (in season)	1 slice			31 ______
Strawberries (fresh, in season)	½ cup			35 ______
Oranges	1 medium			39 ______
Orange juice or grapefruit juice	6 oz. glass			43 ______
Grapefruit	(½)			47 ______
Tang, Start breakfast drinks	6 oz. glass			51 ______
Other fruit juices, fortified fruit drinks	6 oz. glass			55 ______
Any other fruit, including berries, fruit cocktail	½ cup			59 ______
VEGETABLES – GARDEN ONLY		S M L	Da Wk Mo Yr Nv	
String beans, green beans	½ cup			63 ______
Peas	½ cup			67 ______
Chili with beans	¾ cup			71 ______
Other beans such as baked beans, pintos, kidney beans, limas	¾ cup			75 ______ D 79 80
Corn	½ cup			11 ______
Winter squash, baked squash	½ cup			15 ______
Tomatoes, tomato juice	(1) or 6 oz.			19 ______
Red chili sauce, taco sauce, salsa picante	2 Tblsp. sauce			23 ______
Broccoli	½ cup			27 ______
Cauliflower or brussel sprouts	½ cup			31 ______
Spinach (raw)	¾ cup			35 ______
Spinach (cooked)	½ cup			39 ______
Mustard greens, turnip greens, collards	½ cup			43 ______
Cole slaw, cabbage, sauerkraut	½ cup			47 ______
Carrots, or mixed vegetables containing carrots	½ cup			51 ______
Green salad	1 med. bowl			55 ______
Salad dressing, mayonnaise (including on sandwiches)	2 Tblsp.			59 ______
French fries and fried potatoes	¾ cup			63 ______
Sweet potatoes, yams	½ cup			67 ______
Other potatoes, including boiled, baked, potato salad	(1) or ½ cup			71 ______
Rice	¾ cup			75 ______ E 79 80
Any other vegetable, including cooked onions, summer squash	½ cup			11 ______
Butter, margarine or other fat on vegetables, potatoes, etc.	2 pats			15 ______
~~MEAT, FISH, POULTRY & MIXED DISHES~~		S M L	Da Wk Mo Yr Nv	
Hamburgers, cheeseburgers, meat loaf	1 medium			19 ______
Beef—steaks, roasts	4 oz.			23 ______
Beef stew or pot pie with carrots, other vegetables	1 cup			27 ______
Liver, including chicken livers	4 oz.			31 ______
Pork, including chops, roasts	2 chops or 4 oz.			35 ______
Fried chicken	2 sm. or 1 lg. piece			39 ______
Chicken or turkey, roasted, stewed or broiled	2 sm. or 1 lg. piece			43 ______
Fried fish or fish sandwich	4 oz. or 1 sand.			47 ______
Tuna fish, tuna salad, tuna casserole	½ cup			51 ______
Shell fish (shrimp, lobster, crab, oysters, etc.)	5) ¼ cup or 3 oz.			55 ______
Other fish, broiled, baked	4 oz.			59 ______
Spaghetti, lasagna, other pasta with tomato sauce	1 cup			63 ______
Pizza	2 slices			67 ______
Mixed dishes with cheese (such as macaroni and cheese)	1 cup			71 ______

Appendix B

Tables summarizing dietary survey results and estimates of metal intakes.

Table B-1 . Daily consumption of vegetables reported in dietary survey.

Garden Vegetables	Daily Consumption of Vegetables (in grams vegetables/day) Family 1 Individual 1	Family 1 Individual 2	Family 2 Individual 1	Family 2 Individual 2	Family 3 Individual 1	Family 3 Individual 2
string beans, green beans	30.2	7.6	15.1	60.5	45.4	45.4
peas	20.2	11.3	15.1	30.2	0.0	0.0
other beans (pintos, lima, etc.)	30.2	5.7	11.3	22.7	45.4	5.7
corn	0.0	5.0	15.1	0.0	30.2	30.2
winter squash, baked squash	20.2	11.3	3.8	15.1	3.8	2.5
tomatoes, tomato juice	20.0	10.0	15.1	15.1	90.7	39.9
broccoli	0.0	30.2	15.1	30.2	15.1	15.1
cauliflower or brussel sprouts	0.0	15.1	7.6	15.1	15.1	15.1
spinach (raw)	45.4	5.7	0.0	0.0	0.0	0.0
spinach (cooked)	20.2	2.5	15.1	15.1	7.6	121.0
must./turnip greens, collards	10.1	170.1	5.0	15.1	0.0	0.0
cole slaw, cabbage, sauerkraut	0.0	7.6	7.6	15.1	7.6	7.6
carrots	30.2	30.2	30.2	60.5	7.6	7.6
green salad (lettuce)	45.4	170.1	45.4	90.7	17.0	11.3
french fries and fried potatoes	15.1	0.0	3.8	0.0	5.7	11.3
sweet potatoes, yams	0.0	0.0	7.6	0.0	7.6	3.8
potatoes (boiled, baked, salad)	10.0	15.1	60.5	15.1	60.5	60.5
beets	10.0	10.0	30.2	0.0	0.0	0.0
onions	20.0	0.0	30.2	0.0	226.8	45.4
summer squash	20.0	0.0	0.0	0.0	30.2	30.2
green pepper	20.0	0.0	0.0	0.0	0.0	0.0
asparagus	0.0	0.0	30.2	0.0	15.1	30.2
herbs (dried)	0.0	68.0	0.0	0.0	0.0	0.0
Total daily consumption	386.9	666.3	405.7	415.8	697.4	503.6

Underlined values are estimated due to missing information in surveys.
conversions: 1 cup = 8 ounces, 1 ounce = 28.35 grams, 1 cup = 226.8 grams

Table B-2 . Concentrations of metals in vegetables used in estimating daily intakes of metals.

Garden Vegetable (source of concentration)	dry to wet weight conversion	Concentration of Metals in Vegetables** ug/gm (wet weight)			
		Arsenic	Cadmium	Lead	Manganese
string beans, green beans (used corn lit. value)	0.12	NA	0.2	0.1	4.1
peas (used corn lit. value)	0.12	NA	0.2	0.1	4.1
other beans (lit)	0.12	NA	0.2	0.1	4.1
corn (lit)	0.12	NA	0.2	0.1	4.1
winter squash, baked squash (used broccoli)	0.21	NA	0.1	0.2	7.2
tomatoes, tomato juice (lit)	0.12	NA	0.0	0.1	4.1
broccoli (measured)	0.10 *	NA	0.1	0.1	1.2
cauliflower/brussel sprouts (used broccoli)	0.10	NA	0.1	0.1	1.2
spinach (raw) (used lettuce)	0.08	NA	0.4	0.1	15.6
spinach (cooked) (used lettuce)	0.08	NA	0.4	0.1	15.6
must./turnip greens, collards (used cabbage)	0.08 *	NA	0.1	0.1	0.9
cole slaw, cabbage, sauerkraut (measured)	0.12	NA	0.1	0.1	1.4
carrots (measured)	0.12 *	NA	0.1	0.1	4.1
green salad (lettuce) (measured)	0.07 *	NA	0.4	0.1	13.7
french fries and fried potatoes (measured)	0.21	NA	0.1	0.2	1.5
sweet potatoes, yams (used potatoes)	0.21	NA	0.1	0.2	1.5
potatoes; boiled, baked, salad (measured)	0.21 *	NA	0.1	0.2	1.5
beets (measured)	0.13 *	NA	0.1	0.1	7.0
onions (used garlic)	0.21	NA	0.1	0.2	0.8
summer squash (used corn lit. value)	0.21	NA	0.4	0.2	7.2
green pepper (used corn lit. value)	0.21	NA	0.4	0.2	7.2
asparagus (used corn lit. value)	0.21	NA	0.4	0.0	7.2
herbs (dried) (used lettuce)	1.00	NA	0.0	0.0	34.3

NA = not available.

Concentrations of metals in vegetables reported in dry weight. Since consumption of vegetables are reported in wet weight, dry weight concentrations were converted to wet weight concentrations based on percent water content of vegetables (USDA, 1984). Conversion factors are equal to (100 - % water content) divided by 100.

* Information on % water content derived from USDA, 1984. Vegetables without * were estimated from water content of vegetables cited from USDA, 1984.

**Maximum concentrations from Northport were used to estimate intakes.

measured = actual concentrations measured in Northport gardens.

used "vegetable" = used concentration of similar vegetable measured in Northport as an estimate. Vegetable in " " is the vegetable that was used as substitute.

from "lit." = used concentration of metal reported in scientific literature where Northport data unavailable.

Concentrations of metals in vegetables from literature:

cadmium in corn, 1.84 ppm (dry wt.) in 2.5 ppm cadmium soil (MaClean, 1976)

cadmium in tomatoes, 0.23 ppm (dry wt.) in 2.5 ppm cadmium soil (MaClean, 1976)

Table B-3. Daily Intake of Metals from Garden Vegetables.

	Daily Intake of Metals from Garden Vegetables (mg/day)			
	Arsenic	Cadmium	Lead	Manganese
Family 1				
Individual 1	NA	0.048	0.039	1.258
Individual 2	NA	0.097	0.065	4.348
Family 2				
Individual 1	NA	0.043	0.042	1.097
Individual 2	NA	0.050	0.047	1.817
Family 3				
Individual 1	NA	0.060	0.061	1.020
Individual 2	NA	0.053	0.049	1.925

Daily Intake of Metal(i)=daily consumption of vegetable(i) x concentration (wet wt) of metal in vegetable(i)

Table B-4. Daily Dose of Metals from Garden Vegetables

	Daily Dose of Metal from Garden Vegetables (mg/kg/day)			
	Arsenic	Cadmium	Lead	Manganese
Family 1				
Individual 1 (female)	NA	0.0008	0.0006	0.0210
Individual 2 (male)	NA	0.0014	0.0009	0.0621
Family 2				
Individual 1 (male)	NA	0.0006	0.0006	0.0157
Individual 2 (female)	NA	0.0008	0.0008	0.0303
Family 3				
Individual 1 (male)	NA	0.0009	0.0009	0.0146
Individual 2 (female)	NA	0.0009	0.0008	0.0321

Daily Dose = Daily intake of metal (mg/day) / bodyweight (70 kg male, 60 kg female)

Appendix C

Background concentrations of metals in soils in Washington State and concentrations of metals in soil in Trail, B.C.

This appendix provides some information about how the metal concentrations found in Northport compare to other areas of the state, in general, and to other areas of known metal contamination. Although some comments are presented on how Northport soil and vegetable concentrations compare to other areas, these comments are judgments made by inspecting the data and do not represent actual statistical comparisons.

- **Background Concentrations of Metals in Soils in Washington State**

Ecology recently published a report entitled, Natural Background Soil Metals Concentrations in Washington State (Ecology, 1994). The primary objective of the Ecology report is "to define a range of values that represent the natural concentration of metals in surficial soils throughout Washington State" (Ecology, 1994). Samples were generally collected from undisturbed or undeveloped areas, implying that soils were not collected from gardens.

The Ecology report presents data from 490 soil samples (surface to a depth of 3 feet) collected from 166 sites throughout Washington. Samples were not collected uniformly across the state, but instead focused on regions representative of geology, soils, and climate of other regions. Some counties were not sampled at all. The soil data from counties that were sampled were divided into nine groups; Puget Sound (Snohomish, King, Pierce, Thurston, Mason, Jefferson, Island, San Juan, and Clallam Counties), Group "W" (Whatcom, Skagit, Grays Harbor, Lewis, and Pacific Counties), Clark County, West-all (all sampling locations west of the Cascade Mountain Range), Statewide (all statewide sampling locations), East-all (all sampling locations east of the Cascade Mountain Range), Yakima Basin (Yakima, Kittitas, Chelan, and Grant Counties), Spokane Basin (Stevens, Spokane, Lincoln, and Pend Oreille Counties) and Group "E" (Benton, Spokane, Lincoln, Adams, Okanogan, and Whitman Counties). Additionally, sampling also focused on four large urban areas within the representative regions.

Background soil concentrations of arsenic, cadmium, lead, and manganese reported for the Statewide, East, and Spokane Basin regions are summarized below in Table C-1. The concentrations of arsenic, cadmium, lead, and manganese measured in Northport gardens are listed in the last row of Table C-1 for comparison.

Table C-1. Summary of background concentrations of metals in soils from various geographical areas of the state (Ecology, 1994)

	Metal Concentration (mg/kg): median (min, max)			
Geographic Area (N)	arsenic	cadmium	lead	manganese
Statewide (166)	2.92 (0.5, 28.6)	0.49 (0.1, 5)	7.9 (2.1, 207.5)	509.58 (78, 2750)
East (80) (all sampling locations east of the Cascade Mountains)	2.95 (0.5, 28.6)	0.45 (0.125, 1.32)	7.82 (2.17, 17.1)	490.75 (164.45, 1546.12)
Spokane Basin (27) (Stevens, Spokane, Lincoln, and Pend Oreille Counties)	4.99 (1.13, 10.32)	0.395 (0.125, 0.685)	10.8 (6.75, 16)	470 (354.5, 769.5)
Northport Gardens	56-113	2.09-2.8	66.5-106	336-964

Based on this report and on the limited number of garden soil samples collected in Northport, it appears that the concentrations of arsenic, cadmium, and lead in Northport garden soil are higher than background soil concentrations of these metals in the state. Concentrations of manganese in soil in Northport appear to be similar to background soil concentrations in other parts of the state.

- **Concentrations of Metals in Soil in Trail, B.C.**

The Trail Lead Study was conducted in Trail, B.C. during 1989 by the B.C. Ministry of Environment to investigate blood lead levels in children and to identify their environmental determinants (Trail Lead Program, 1991). Part of this study consisted of analyzing soil samples for lead. A follow-up study re-analyzed 198 of the 237 soil samples collected in the initial study for levels of several metals including arsenic, cadmium, manganese, and lead. The goals of the follow-up study were to: (1) examine the extent of possible heavy metal soil contamination that might affect children in Trail, B.C., and (2) investigate whether there is a link between soil lead and other heavy metal concentrations.

These studies measured concentrations of metals in three types of soil: sandbox soil, park soil, and residential soil. Cadmium and arsenic, along with copper, mercury, silver and zinc, were all found to correlate spatially with lead in all three types of soils sampled. The report states that "this strongly suggests that all soils are contaminated from a similar source." The levels of arsenic, cadmium, lead, and manganese found in the initial and follow-up studies are summarized below in Table C-2.

Table C-2. Summary of the results of Trail, B.C. soil sampling studies.

	detection limit (ppm)	Sandbox Soils (35 samples)			Park Soils (41 samples)			Residential Soils (122 samples)		
		mean	min	max	mean	min	max	mean	min	max
Metal (ppm)										
arsenic	5.0	24.5	nd	129	18	nd	50	48.38	nd	352
cadmium	0.1	5.85	0.2	34.9	4.58	0.7	21.8	14.64	0.2	71.9
lead	1.0									
initial[1]		378.7	15	2940	245.9	25	1060	1089	13	7140
follow-up		420.5	20	2800	248.6	24	1010	1146	23	6960
manganese	0.5	342.3	161	787	350.1	204	598	440.7	202	1050

[1]Initial study based on 237 samples from residential sites and 84 from parks, analyzed for lead only. nd = not detected.

A subset of the residential soil samples from the follow-up study were collected from gardens. A total of 31 garden soil samples were collected. The garden soil data from this study are summarized below in Table C-3.

Table C-3. Summary of metal concentrations from garden soils (31 samples) in Trail, B.C.

	Metal Concentration (ppm)				
	lead (initial)	lead (follow-up)	arsenic	cadmium	manganese
Mean	1028.0	1191.7	42.6	16.1	479.0
Min	49	63	8	0.95	257
Max	5750	5600	179	71.9	829

This study provided several recommendations for further work including: an assessment of factors thought to affect exposure and bioavailability of heavy metals in soils, the possibility of biological monitoring for arsenic and cadmium, and consideration of the feasibility of doing neurobehavioral assessments on children.

According to Steve Hilts of the Trail Lead Program, they are currently proposing to address the issue of bioavailability, but are not pursuing biological monitoring due to the difficulty in interpreting results (Steve Hilts, personal communication). A baseline risk assessment for childhood lead exposure using EPA's IEUBK model was recently completed by the Trail Lead (Trail Lead Program, 1995a). This report evaluated the applicability of using EPA's IEUBK model for developing remedial actions and concluded that blood lead levels should be the primary criterion for determining the efficacy of remedial actions. Additionally, a Trail Lead Report, Exposure Pathways Investigations, reports that there is no statistical difference between the blood lead of children who eat produce from their home gardens and children who do not (Trail Lead Program, 1995b). This implies that eating vegetables from home gardens is not a major route of exposure to lead compared to other routes such as incidental ingestion of soil, frequency of washing hands, etc. Based on this result, the Trail Lead Program has not issued warnings regarding consuming garden vegetables (Steve Hilts, personal communication)

Lead and cadmium soil concentrations appear to be much higher in Trail B. C. than in Northport. Alternatively, the arsenic concentrations in soil appear to be similar in Northport and Trail, B.C. Additionally, the arsenic concentration measured in the control garden soils from a Rochester garden is also similar to those in Northport and Trail, B.C. The source of the arsenic in Rochester is unknown, but soils there appear to be elevated above background as well, when compared to Ecology's report (Ecology, 1994). We might expect that the concentrations of arsenic, cadmium, and lead would all be proportionally high in Northport compared to Trail, but this does not appear to be the case given these limited data. The concentration of manganese appears to be comparable between the two areas.

Appendix D

Derivation of background cadmium intake from diet.

In a previous DOH report, the derivation of a critical renal concentration of cadmium was presented in order to establish whether environmental exposures (from diet and from air) in Northport could result in exceedances of a critical renal concentration of 50 ug/g and possibly produce adverse impacts on the kidney (Appendix F; DOH, 1994). Using the equations outlined in that report, and solving for the daily dietary intake of cadmium at a critical renal concentration of 50 ug/g, 87 ug/day of cadmium in the diet is allowed before the critical renal concentration may be exceeded. A daily dietary intake of cadmium of 75 ug/day was used in the DOH's 1994 report as an estimate of the background dietary intake of cadmium for the general population (Friberg, 1974). The difference of these two values (87 ug/day - 75 ug/day) is 12 ug/day cadmium, which is the maximum dietary intake of cadmium above the background dietary intake which is of concern for kidney impacts.

Since the 1994 report, however, we have revised the estimates of background dietary intake of cadmium for the general population based on recent analysis of cadmium in food in the United States conducted by the FDA (Gartrell et. al., 1986; Gunderson, 1988). For this assessment, a range of dietary intakes estimated for the general population of 15.4 - 32 ug/day are used, which are the upper estimates of dietary cadmium intakes from the Gartrell and Gunderson studies. Using these background values results in allowable dietary cadmium intakes above background of 71.6 - 55 ug/day. These values are greater than the daily dietary intake above background of 12 ug/day cadmium previously used to assess possible health impacts.

Converting 71.6 ug/day and 55 ug/day into daily doses results in 0.001 mg/kg-day and 0.0008 mg/kg-day, respectively, for a 70 kg adult. Table 2 in the main text shows that the estimates of daily intakes from Northport garden vegetables fall within this range of estimates of allowable daily dietary intakes of cadmium above background dietary intakes. Although this comparison suggests that the intake of cadmium from garden vegetables is within a range of intakes that is not expected to result in exceedances of a critical renal concentration, it is close to a level of concern especially for long term exposures and does not allow any margin of safety.

ISTINE GEBBIE
ecretary

STATE OF WASHINGTON

DEPARTMENT OF HEALTH

OFFICE OF TOXIC SUBSTANCES

Airdustrial Center, Building 4 • P.O. Box 47825 • Olympia, Washington 98504-7825

July 31, 1992

TO: North Tri-County Health District and Interested Citizens

FROM: Kim Field, Public Health Advisor
Environmental Health Assessment Section

SUBJECT: Health Concerns In Areas Of Northeast Tri-County

The Washington State Department of Health (DOH) has prepared the attached summary of activities since the May 28, 1992 public meeting.

The summary is compiled from information obtained from: 1) the public meeting, 2) citizens' reports, 3) local physicians, and 4) the epidemiologic investigation of inflammatory bowel disease (ulcerative colitis and Crohn's disease).

DOH, Office of Toxic Substances is working with Washington State Department of Ecology, Northeast Tri-County Health District, Department of Natural Resources, United States Geographical Survey, DOH, Drinking Water Section, and United States Environmental Protection Agency, Region 10 Air Program in order to compile historical environmental data. Included in this summary is a list of ongoing and proposed activities by the DOH and the other agencies.

Reports to follow in October 1992 and January 1993 will include information derived from epidemiological and toxicological review and air, soil and biological sampling. It will also include a proposal for follow-up activities based on the analysis of the information.

If you need further information, please contact me at (206) 586-6179.

Attachment

anc:\wp51\data\kim\nportsum.mem

Preliminary Assessment Of Health Concerns In Areas Of Northeast Tri-County

This is an initial report to the community and the Northeast Tri-County Health District about what the Washington State Department of Health (DOH) has discovered through the end of July 1992. There are three major sections; 1) summary of health concerns identified by the community and early investigations by DOH, 2) identified potential sources of environmental contamination within the area, and 3) DOH proposed activities for the period August 1992 - January 1993.

Background

For several years residents of the Northport and Kettle Falls areas have been concerned about the prevalence of illnesses in their communities. Many of these residents believe that the illnesses result from exposure to environmental contaminants. Community groups have sent several reports to the DOH documenting their concerns. A 1987 report resulted in an epidemiologic investigation by DOH of cases of inflammatory bowel disease (IBD). The most recent reports were received in May and June 1992.

On May 28, 1992, DOH held a public meeting to obtain information on health complaints. An estimated 200 citizens from the Northport, Kettle Falls, and Colville areas attended the meeting. Approximately 30 residents gave public testimony. Additional residents spoke about health concerns to representatives of DOH after the meeting.

Summary Of Health Concerns

Elevated Manganese

A local physician reported several patients in the Northport/Kettle Falls area had elevated levels of manganese (Mn) in blood and urine. According to the physician, a sample of employees from the Washington Water Power Woodwaste Generator (Kettle Falls) had slightly elevated levels of Mn, but did not display symptoms of toxicity. The physician expressed concern about the reliability of the laboratory measurements in this sample.

Other samples that were analyzed at a different laboratory showed variable levels of Mn in residents of the Northport area. Several samples reportedly were in the upper end of the normal range and at least one sample was above the upper limit of normal. None of the above data has been received by DOH for evaluation.

In addition to the information from the physician, DOH received a report from a citizen in Kettle Falls who has been diagnosed with Mn poisoning. The well from which this person obtained water was sampled by DOH in April 1990. Manganese was found at 8.3 parts per million (ppm). This concentration exceeds the Washington State drinking water secondary maximum contaminant level (MCL) of 0.05 ppm.[1] The May 1992 citizens' report contained one case of Mn poisoning from Northport. It is not known whether these two cases are duplicates of those reported by the local physician.

Epidemiologic studies of workers with long-term exposure to Mn dust have identified the central nervous system and the lungs as the main target organs for toxic effects of inhaled Mn. (1) While the health effects of Mn exposure in the general population do not appear to be well documented, a 1989 study indicated an association between concentration of Mn in drinking water and prevalence of neurological signs associated with Parkinson's disease in individuals age 50 and older. (2) Because the study used a composite score for neurological symptoms, it is not possible to delineate which symptoms were most prevalent. Tremor, rigidity, and akinesia-dyskinesia are the primary symptoms of Parkinson's disease. Concentrations of Mn in drinking water associated with low, medium, and high prevalence of symptoms were 3.6-14.6 microgram per liter (μg/l), 82.6-252.6 μg/l and 1800-2300 μg/l.

Inflammatory Bowel Disease

Ulcerative colitis (UC) and Crohn's disease (CD) are the most common manifestations of IBD. In 1988, Dr. Robert Davis, DOH, investigated a reported cluster of UC and CD in the Northport area. After examining medical records and obtaining independent assessment of biopsy slides, Dr. Davis identified four cases of UC and two cases of CD from four families. An additional case of UC was noted in the medical records of a resident who developed colon cancer, but slides for histological validation of the diagnosis of UC were not available. Three of the families reported symptoms of IBD in siblings of the cases.

The combined annual incidence of UC and CD is estimated to be between 5 and 15 cases per 100,000 population. (3) Dr. Davis estimated the expected number of new cases of UC and CD for Northport township from 1970 to 1987 to be between 0.5 and 1.6. Therefore, the six confirmed cases represent approximately 3.7 to 11.1 times the expected number. This is a conservative estimate, because 1) the colon cancer case, which most likely represents a case of colitis, was not included, and 2) there was no active case finding on the symptomatic but undiagnosed siblings of the cases.

Since there appears to be a genetic component to UC and CD, Dr. Davis obtained family histories dating to the late 1800s for the five families (four families with confirmed cases and the family of the colon cancer case). He concluded that there was no familial association.

Dr. Davis used hospital discharge data, Comprehensive Hospital Abstract Reporting System (CHARS), from 1985 to 1987 and population estimates for 1984 to calculate hospitalization rates

[1] Secondary MCLs are not based on adverse health effects, but rather on aesthetic effects, such as taste. The United States Environmental Protection Agency is in the process of proposing a health based MCL for manganese in drinking water.

for UC and CD by county in Washington State. Based on these data, the rate for Stevens County was not high compared to other counties.

Three limitations of this analysis are noted. 1) Personnel responsible for the CHARS data set indicate the quality of the data is questionable before 1987. 2) Dr. Davis was not able to use unduplicated counts. Therefore, if someone was hospitalized three times for UC or CD, the person would appear as three cases. It is possible that repeat hospitalizations for these conditions are more frequent in some counties than in others due to non-illness related factors, such as hospital accessibility and insurance coverage. It is not known how these non-illness related factors effect hospitalization rates for Stevens County relative to the other counties. 3) Use of 1984 population estimates may cause rates to be over- or under-inflated. In relatively sparsely populated counties, such as Stevens County, over-estimates of the population can lead to underestimates of rates and visa versa.

Examination of the well water from two of the families in which there were three confirmed cases of UC and one case of CD revealed no bacterial pathogens. Evaluation of metals showed levels within acceptable limits set by the United States Environmental Protection Agency (EPA) and DOH.

Because there is some suggestion in the literature that atypical mycobacterium may be causally related to IBD, Dr. Davis calculated morbidity, as reflected by hospitalization, and mortality rates for all types of tuberculosis by county. Stevens County showed no excess morbidity or mortality from these diseases.

The May 1992 citizens' report listed 18 cases of "colitis, ileitis, etc." An additional three cases were reported at the community meeting. Five of these cases duplicated those confirmed by Dr. Davis. At least two of these cases were investigated by Dr. Davis, but at the time they did not have biopsy confirmed disease. The most recently diagnosed case appears to have been within the past year, suggesting the possible continued presence of a causative agent.

Despite much study, the etiology of IBD remains obscure. Both genetic and environmental factors seem to play a role in disease onset. However, neither biological mechanisms nor specific etiological environmental factors have been identified. The evidence for a genetic component in the etiology of IBD is derived from the observation that IBD clusters in families and that the disease is more prevalent in some ethnic and racial group than in others. (3,4) The association between rates of IBD and degree of industrialization provides evidence for an environmental component in the etiology of IBD. More complete diagnosis in industrialized areas is not believed to account for all of these differences. (3,4)

Cancer

The May 1992 citizens' report cites 43 cases of cancer over the last 20 years in an estimated population of 700. At this time DOH has not conducted a formal analysis of cancer mortality in the Northport area. However, given that approximately one out of four people in the United States dies of cancer, 43 cases of cancer, 32 of whom are deceased, are not necessarily indicative of excessive cancer mortality. DOH will compare rates of cancer (particularly brain and colorectal cancers) mortality in Stevens County and Northport to rates for Washington State and the United States in order to confirm an elevated cancer rate.

The report lists eight cases of brain tumors and one case of brain cancer in a separate section. It is not known whether the tumors are benign or neoplastic.

Thyroid Disease

Approximately 20 cases of thyroid disease were reported either at the public meeting or in the citizens' reports. The types of thyroid disease were not specified. Estimates of rates of disease are not currently possible, since the population base from which the above reports are derived is not clear.

The epidemiology of thyroid disease has not been well characterized. The total prevalence rate for thyroid disease among 41-year-olds in a non-iodine deficient area of Sweden was 7.9 percent. (5) The author reports that this rate is in the same range as those reported in three studies conducted in the 1950s and 1960s in the United States. However, 78 percent of the cases were newly diagnosed as part of the study. Therefore, one would expect substantially lower rates without active case finding.

Iodine deficiency is a known cause of thyroid disease. Iodized salt was introduced in the 1930s to reduce the prevalence of iodine deficiency. Historically, Northport is an iodine-deficient area. (6) It is not known when iodized table salt became available in Northport nor has the extent of its use been ascertained. In addition to iodine deficiency, naturally occurring substances in foods and bacterial and chemical contaminants in water have been associated with thyroid disease. (7)

Neuropathy

Seven cases of what appear to be peripheral neuropathies (numbness or tingling sensations in limbs or other areas of the body) were reported at the public meeting. One case seemed to be related to manganese poisoning. Among the six remaining cases, two clusters were reported. One cluster involved a husband and wife. The husband suspects that using river water for irrigation of the garden lead to the problem which resolved when this practice was stopped. The second apparent cluster involved two members of the same family and a neighbor. No suspected cause has been identified and the problem is on-going.

Peripheral neuropathies can result from exposure to a number of environmental contaminants, including some metals, industrial solvents, and selected fumigants, insecticides, and herbicides.

Respiratory and Related Disease

Speakers at the public meeting voiced numerous complaints of respiratory and related illnesses which they believe to be related to poor air quality. Citizens testified to visible air pollution, noxious odors and tasting the air. A related complaint of rapidly rusting barbed wire was also received. The citizens' report received in June contained similar complaints.

Lead Poisoning

Trail, British Columbia is the site of the world's largest lead-zinc smelter. The smelter is located approximately 16 miles north of Northport. Dr. Nelson Ames from the Ministry of Health in British Columbia reported that 40 percent of the children living in Trail, British Columbia have blood lead levels above 15 micrograms per deciliter (μg/dL). Levels of blood lead in the children were highly correlated with soil concentration. It has not been ascertained whether the lead in the soil represents current or a historical deposition. Dr. Nelson Ames reported that levels of soil lead are only problematic within six miles of the smelter.

Northport was the site of a zinc-lead smelter reportedly to have closed in the 1940s. A community resident related that in the 1930s the pollution was so bad that horses became sick from "picking up lead from the ground."

Relatively low levels of blood lead have been related to learning disorders in children. (7) A teacher at a local public school reported what he believed to be a high number of children with attention deficit disorder compared to children he has taught in other schools. He also said that other teachers concurred with his assessment.

Potential Sources of Environmental Contamination

Many of the area residents believe that the abundance of illness is due to environmental contamination. Industrial, manufacturing, mining, and agricultural activities and geological deposits may be potential sources for contamination of air, water, and soil from metals and organic chemicals.

To identify present and historical sources, the DOH, Office of Toxic Substances has been assisted by the Northeast Tri-County Health District, DOH, Division of Drinking Water, Washington State Department of Ecology (Ecology), Washington State Department of Natural Resources (DNR), United States Geological Survey (USGS), and EPA, Region 10.

Northeast Tri-County Health District

DOH and the health district will work on a proposal to provide lead testing to a specific group of children ages 1 to 3 in Northport and areas north of Northport.

DOH, Division of Drinking Water

The Eastern Operations Section will provide historical drinking water data for Northport.

Washington State Department of Ecology

Appropriate staff members within Ecology have been contacted to provide Water Well Information, Contaminated Site Data, Water Quality and Sediment Data, and Ambient Air Data.

Water Well Information

The DOH is in the process of developing a formal request to Ecology for this information.

Contaminated Site Data Northport and Kettle Falls Area

Ecology has provided the following information regarding contaminated sites:

1. Washington State Department of Transportation
   Star Route 25
   Mile Post 113
   Northport

   Fifteen cubic yards diesel contaminated soil has been removed and site remediated (site closure--June 1991).

2. Washington Water Power
   Kettle Falls
   Highway 395

   Diesel contaminated soil removal (site closure--January 1992)

3. Boise Cascade Sawmill and Plywood Mill Highway 395

   Sawmill-Diesel and gas contaminated soil removed (site closure--December 1991)

   Plywood Mill-Diesel contaminated soil removed (site closure--May 1990)

4. Kettle Falls School District
   Kettle Falls Elementary
   720 N Oak

   Gasoline contaminated soil with monitoring wells for groundwater (remediation and closure--July 1992)

5. Onion Creek School

   Soil contamination with gasoline at 165 ppm (not above cleanup standards). (No remediation required--closure September 1989)

Ambient Air Data

Ecology has provided the following limited ambient air quality data for 1985:

1. Thompson Farm Station

   Suspended particulate sampling started on September 21, 1983, and discontinued in August 1985. None of the measurements were above the state standard of 150 μg/m3 or the federal standard of 260 μg/m3 for suspended particulate. The highest level of 133 μg/m3 occurred on May 30, 1984. The average of all the measurements is about 27 μg/m3.

2. Ecology is planning to use its mobile air van in the Northport area to monitor PM10, sulfur dioxide, carbon monoxide, and ozone.

Washington State Department of Natural Resources

DNR, Division of Geology and Earth Resources is preparing plot out maps for producing mines (2500 tons or more) for the Northport area--T40N, T39N, R39E, R40E, R41E. The commodities present in these mines include lead, zinc, gold, and copper. Also, included will be data from the United States Bureau of Mines.

DNR reported there are natural soil deposits of lead, zinc and uranium in the Northport area. In the near future there will be a database available to retrieve data regarding uranium deposit sites.

DNR has no requirement to report location of mines, ore assay information or analysis of tailing ponds.

DOH will obtain DNR documents #90-18 Metallic Mines of Washington and Bulletin 37-Inventory of Washington Metallic Minerals Part II. These documents catalogue all reported producing mines.

United States Geological Survey

The USGS has no ground water monitoring data for the Northport area.

United States Environmental Protection Agency, Region 10

1. The EPA Air Program has contacted DOH regarding health concerns relating to air emissions. EPA has been working with the Canadian government to develop air quality standards and a permit process for industrial air emissions. Upon request by DOH they will provide modeling of air emissions from Canadian industrial facilities. Modeling may point to a source and provide geographical dispersion data.

2. The DOH is in the process of requesting from EPA an update list of Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) sites for Stevens County.

Department of Energy

At the May 28, 1992, Northport meeting a citizen commented to a member of the DOH staff that he had been aware of "heavy water" production in the Northport area. DOH staff has not been able to locate this citizen for follow-up of this potential source of environmental exposure. DOH will need a geographical location for this activity to obtain further information from the United States Department of Energy (DOE) (formerly Atomic Energy Commission).

Department Of Health Proposed Activities, August 1992 - January 1993

Epidemiologic Review

1. Compare rates of cancer (particularly brain and colorectal cancers) mortality in Stevens County and Northport to rates for Washington State and the United States.

2. Compare rates of hospitalizations for Ulcerative colitis and Crohn's disease for Stevens County and Northport to rates for selected control counties.

3. Follow-up on unconfirmed cases of UC and CD:
   a. obtain medical records to confirm diagnosis;
   b. geographic mapping and rate determination.

4. Follow-up on thyroid cases:
   a. obtain medical records to confirm diagnosis;
   b. geographic mapping and rate determination.

5. Follow-up on selected peripheral neuropathies to ascertain possible exposure to environmental contaminants. *Toxicological Review*

6. Conduct literature review of goitrogens in water.

7. Review list of suspected pollutants for links with reported diseases.

Air, Soil, and Biological Sampling

8. Nominate Northport as one of the sites targeted in the lead soil sampling project.

9. Work to obtain funding for blood lead testing in specific group of children ages 1 to 3 residing in Northport and areas north of Northport.

10. Obtain manganese blood and urine data from the local physician and asses the need for additional testing.

11. Collaborate with Ecology in ambient air monitoring activities.

Report and Follow-up

Current schedule is for the DOH to provide an interim report to the community and Northeast Tri-County Health District in October 1992 and January 1993. It will also include proposal for follow-up activities based on the findings.

Once a report has been forwarded to the Northeast Tri-County Health District and community groups, DOH will, if necessary; 1) collaborate with the health district and citizens' groups to delineate and prioritize further activities, and 2) assist the community and the health district locate sources and apply for funding for priority projects.

References

1. Roels, H., Lauwerys, R., Buchet, J.P. *et al.* Epidemiological survey among workers exposed to manganese: effects on lung, central nervous system, and some biological indices. *American Journal of Industrial Medicine, 11*:307-327, 1987.

2. Kondakis, X.G., Makris, N., Leotsinidis, M. Possible health effects of high manganese concentration in drinking water. *Archives of Environmental Health, 44*:175-178, 1989.

3. Calkins, B.M. and Mendeloff, A.I. Epidemiology of Inflammatory Bowel Disease. *American Journal of Epidemiology, 8*:60-91, 1986.

4. Gilat, T., Langman, M.J.S. and Rozen, P. Environmental factors in inflammatory bowel disease. *Front. Gastrointestinal Research, 11*:158-176, 1986.

5. Ericsson, U.B. and Lindgarde, F. The epidemiology of thyroid disorders in a seaport community in southern Sweden. *Journal of Clinical Epidemiology, 43*:645-650, 1990.

6. Gray, E.W., MD, Personal Communication.

7. Gaitan, E. Goitrogens in food and water. *Annual Reviews in Nutrition, 10*:21-39

SUMMARY OF HEALTH CONCERNS IN NORTHPORT

Northport, Washington is located eight miles south of the Canadian border on the east side of the Columbia River in Stevens County. Residents of the Northport area have been concerned about the prevalence of illnesses in their community for some time. Health problems mentioned include inflammatory bowel disease, cancer, thyroid disease, peripheral neuropathy, respiratory disease, and lead poisoning.

At the request of the Northeast Tri-County Health District (NETCHD) and interested citizens, DOH held a public meeting in Northport on May 28, 1992, to hear citizens concerns regarding health effects related to environmental conditions. An estimated 200 citizens from the Northport, Kettle Falls, and Colville areas attended the meeting. Approximately 30 residents gave public testimony.

In July 1992, DOH prepared a preliminary assessment of health issues identified by the community and a proposed action plan to address those issues. Progress reports to NETCHD and citizens were issued by DOH on November 30, 1992, and April 30, 1993.

DOH working with the Department of Ecology (Ecology), NETCHD, Department of Natural Resources, U. S. Geological Survey, and U. S. Environmental Protection Agency, Region 10 has taken steps toward addressing some of the concerns raised by the community.

Results and conclusions of these activities were as follows:

COMPLETED ACTIVITIES

Rates of Cancer: Because of the relatively small population of Stevens County, the mortality rates fluctuate from year to year. However, even in 1989 when the rate for Stevens County is the highest, it is not statistically significantly higher than the state rate.

Follow-up on cases of Ulcerative Colitis (UC) and Crohn's Disease (CD): The combined annual incidence of UC and CD is estimated at 5 to 15 cases per 100,000 (6). Based on 600 people living in the Northport area per year, 0.7 to 2.1 new cases of UC and CD would be expected in the Northport area between 1970 and 1992. The eight observed cases are 3.8 to 11.4 times the expected number of cases.

DOH is in the process of contacting medical specialists to review the DOH summary of UC and CD in Northport. This review will assist DOH in referring this work for research into the etiology of UC and CD.

Review of selected peripheral neuropathies: Staff from DOH were unable to contact one of the three individuals identified at the May 1992 meeting. Testing results from two of the individuals do not indicate local environmental exposures. In one case, symptoms are no longer present.

Goitrogens in water: DOH, after reviewing the literature on goitrogens in food and water, has concluded that cobalt may be the most likely exposure. This issue will not receive further consideration unless a review of the medical records indicates an excess of thyroid disease.

Review suspected pollutants for links with reported disease: DOH reviewed suspected environmental pollutants, including cobalt, mercury, lead copper, and deuterium, for possible links with reported diseases. Except for lead, there are no known linkages with these chemicals and current health problems in the Northport area.

Nominate Northport as one of the sites targeted in the lead soil sampling project: In May 1993, environmental lead sampling was performed at elementary schools in Northport, Onion Creek, and two day cares in Colville. The results to date indicate lead levels below levels of health concern.

ONGOING ACTIVITIES

Hospitalizations for UC and CD: A preliminary analysis of hospital discharge data from 1988 to 1990 has been completed. These data do not indicate increased rates of hospitalization for UC and CD in Stevens County compared to the other Washington State counties or the United States. Data is under going quality control check.

Follow-up on thyroid cases: In September 1992, DOH mailed questionnaires and release of information forms to 21 people who were reported to suffer from thyroid disease. These records are presently under review.

Blood lead screening of children ages 1 to 3: December 1992, blood samples were drawn from 22 children. Nineteen children were between 1 and 3 years old, two were 4 years old and one was 5 years old. None of the blood lead levels were above 10 micrograms per deciliter (mcg/dL), indicating that at the time of sampling, in mid-December, there were no children tested who had significant environmental exposure(s) resulting in elevated blood lead.

Obtain manganese blood and urine data from Spokane area physician and assess the need for additional testing: DOH has received laboratory information related to manganese blood and urine screening, but has not reviewed this data.

National Institute of Occupational Safety and Health (NIOSH) inspected and sampled the workplace environment for manganese at the Boise Cascade Corporation plywood plant in Kettle Falls. NIOSH's report should be available to DOH in October or November of 1993.

DOH and NETCHD have developed and implemented a separate plan of action to address the manganese health concerns in the Kettle Falls area. DOH will prepare a separate report that addresses this issue.

Collaborate with Ecology in ambient air monitoring activities: Ecology conducted an ambient air monitoring investigation in the Northport area from December 15, 1992 to February 14, 1993. The results of this investigation, "Northport Lead/Arsenic Air Monitoring Study," are found in Addendum 2. DOH has reviewed the air data and is concerned about air levels of lead arsenic and recommended additional monitoring to characterized potential health effects. Ecology has initiated more extensive monitoring to gather additional data for DOH evaluation.

DOH will continue to work with NETCHD on the blood lead testing of children in Northport. Ecology is currently conducting extensive air quality studies in Northport/Kettle Falls areas. It is anticipated a report on air and biological sampling, including any recommendations for further action will be available by January 1994.

Contact: Kim Field, 586-6179
Date: August 17, 1993

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
OFFICE OF TOXIC SUBSTANCES
Airdustrial Center, Building 4 • P.O. Box 47825 • Olympia, Washington 98504-7825

April 30, 1993

TO: Northeast Tri-County Health District and Interested Citizens

FROM: Kim Field, Public Health Advisor
Environmental Health Assessment Section

SUBJECT: Summary Of Activities And Evaluation Of Health Concerns In Areas Of Northeast Tri-County

---

The Department of Health (DOH) has prepared the attached summary of activities since the November 30, 1992 report. Also, included is an addendum, *Northport Site Investigation, October 22-27, 1992,* that was prepared by David Nash.

The November 30, 1992 report reviewed DOH's activities between July and November 1992, and included three proposals. The proposal to ascertain blood levels of lead and mercury in children was implemented by DOH and Northeast Tri-County Health District.

DOH will continue to work with Northeast Tri-County Health District and the community on prioritizing health concerns addressed in this report. They will also work jointly on locating funding sources.

Attachment

ahc:\wp51\data\nrthprt.mm3

Activities Of Washington State Department Of Health (DOH) Related To Proposals In The July 1992 Report Of Health Concerns In Northport

In July 1992, DOH outlined potential activities to be undertaken in response to community health concerns in the Northport and Kettle Falls areas. In November 1992, DOH provided an up-date describing the activities and status of each proposal. This report summarizes activities undertaken from November 1992 through March 1993, and presents conclusions drawn from activities to date and recommendations for further activities and conclusions. The italicized text are the proposed DOH activities contained in the July report.

Epidemiologic Reviews

1. *Compare rates of cancer (particularly brain and colorectal cancers) mortality in Stevens County and Northport to rates for Washington State and the United States.*

Mortality From All Types Of Cancer

Figure 1 shows mortality rates for all cancers from 1980 to 1991 in Washington State and Stevens County. Because of the relatively small population of Stevens County, the mortality rates fluctuate from year to year. However, even in 1989 when the rate for Stevens County is the highest, it is not statistically significantly higher than the state rate. The 1989 cancer mortality rate for the United States is 199 per 100,000 people.[1] The rate for Stevens County is not statistically significantly different from this figure.

Figure 2 shows how the age distribution of the population of Stevens County changed from 1980 to 1990. Over the decade, the percent of people under 25 years old decreased, while the percent of those aged 45 and older increased. Figure 2 also presents the United States 1989 cancer mortality rates per 100,000 people by age group.[2] It can be seen that rates increase dramatically as age increases. Because the population of Stevens County was relatively older in 1990 compared to 1980, one would expect more cancer in 1990 than in 1980. Approximately 30 percent of those living in the United States will develop cancer.[3]

---

[1] National Center for Health Statistics. Advance report of final mortality statistics, 1989. *Monthly Vital Statistics Report*, vol 40, no 8, supp 2. Hyattsville, MD: Public Health Service, 1992.

[2] National Center for Health Statistics. Advance report of final mortality statistics, 1989. *Monthly Vital Statistics Report*, vol 40, no 8, supp 2. Hyattsville, MD: Public Health Service, 1992.

[3] Holleb AI, Fink DJ and Murphy GP. *American Cancer Society Textbook of Clinical Oncology*. Atlanta: American Cancer Society, 1991.

FIGURE 1
Cancer Mortality Rates

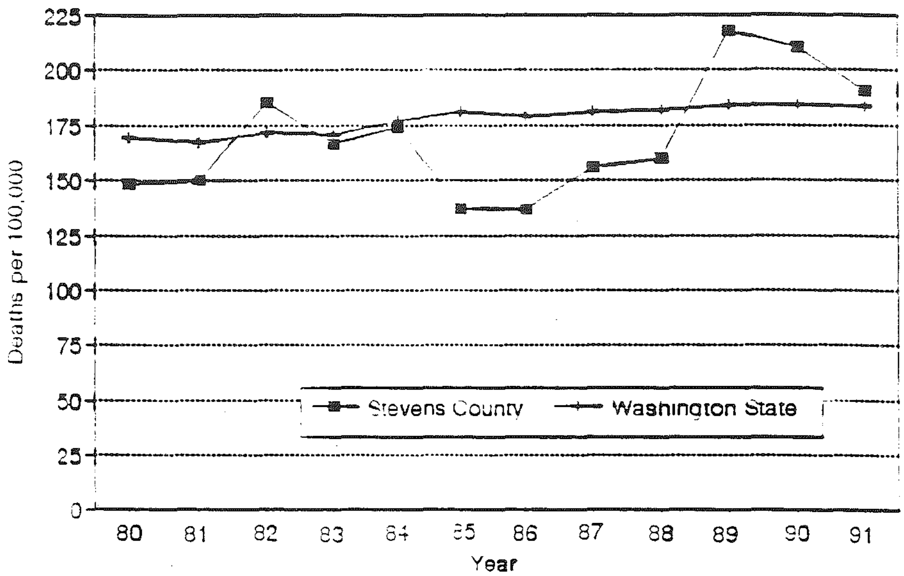
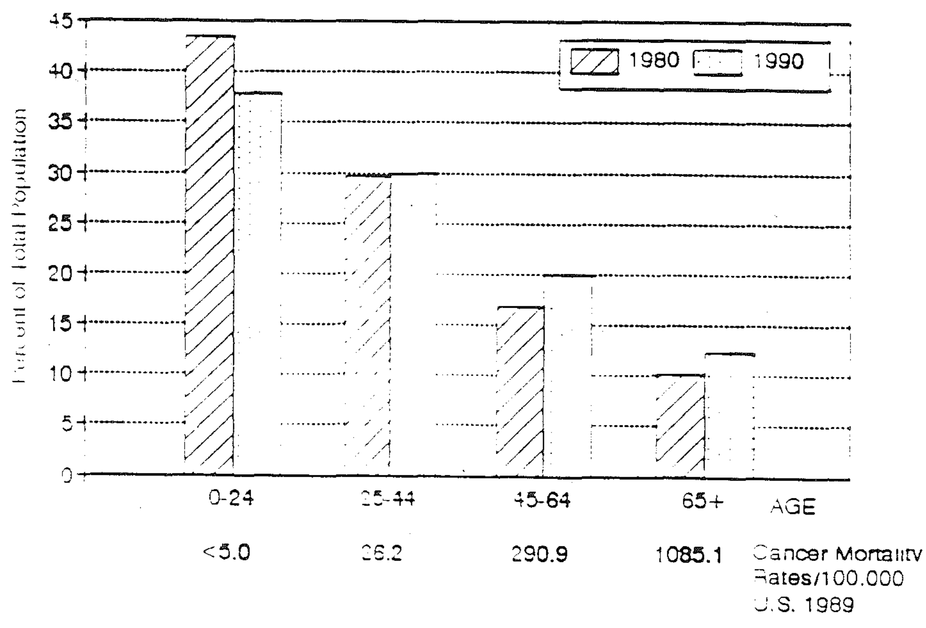


FIGURE 2: Age of Population
1980 versus 1990. Stevens County



Mortality From Selected Cancers

Table 1 shows the number of deaths and mortality rates for thyroid, brain and nervous system, and colorectal cancers from 1980 to 1991, for Washington State and Stevens County. In all instances, the rates are similar. Age-adjusted rates for the United States from 1984 to 1988 are presented for comparison.[4] The United States rates are similar to those from Washington State and Stevens County.[5]

TABLE 1
Rate/100,000 (and Number) of Deaths for Selected Cancers

	Brain and Nervous System	Colorectal	Thyroid
Stevens County	5.2 (19)	20.9 (77)	0
Washington State	5.2 (2757)	20.2 (10751)	0.4 (218)
United States	4.1	20.1	0.4

Northport Cancer Data

In 1988, Washington State began recording zip codes on the death certificate. Between 1988 and 1991, there were five deaths from cancer in the Northport zip code area (99157). When population counts by zip codes become available from the United States Census Bureau, a rate can be calculated. However, the interpretation of that rate may be problematic given the small number of deaths. The Census Bureau is expected to release the zip code information in April 1993. One of the five deaths was from colorectal cancer. Given that colorectal cancer is the third leading cause of cancer mortality for both men and women, one death from this cancer is not unusual.

---

[4] 1984-1988 mortality rate, age-adjusted to the U.S. 1970 population. *Cancer Statistics Review 1973-1988*, National Cancer Institute, NIH Publication No. 91-2789, 1991.

[5] Technical Note: An analysis of the population age structures of Washington State, Stevens County and the United States indicates that non-age-adjusted rates for these groups will not differ significantly from age-adjusted rates.

2. *Compare rates of hospitalizations for ulcerative colitis (UC) and Crohn's Disease (CD) for Stevens County and Northport to rates for selected control counties.*

A preliminary analysis of hospital discharge data from 1988 to 1990 has been completed. These data do not indicate increased rates of hospitalization for UC and CD in Stevens County compared to the other Washington State counties or the United States. The number of hospitalizations from 1988 to 1990 for people living in the Northport zip code area is too small for meaningful statistical analysis. A full description of the findings from the hospital discharge data will be presented after quality control computer runs are completed.

3. *Follow-up on unconfirmed cases of UC and CD:*
   a. obtain medical records to confirm diagnosis;
   b. geographic mapping and rate determination.

In September, DOH mailed questionnaires and release of information forms to 18 people who were reported to suffer from UC or CD. The report of an additional case made a total of 19 people who were believed to have inflammatory bowel disease. Five of these people stated that they did not have inflammatory bowel disease and did not provide medical records or complete the questionnaire.

Of the remaining 14 individuals, seven sets of records have been received and two sets are pending. In three cases, records were either unavailable or the person did not want them released to DOH. Two people were mailed forms a second time after a telephone conversation, but DOH has not received material from them.

The seven sets of medical records were reviewed independently by a registered nurse and an epidemiologist. The reviewers concurred on their findings in all cases. For four individuals, a diagnosis of ulcerative colitis or closely related condition was identified. For three people, a diagnosis of UC or CD could not be made from the records.

One, and possibly two, of the four cases seem to originate outside of the area which was considered in Dr. Robert Davis' study. (See the July report for a summary of Dr. Davis' findings). However, two of the cases are in the area described by Dr. Davis and can be added to the six cases he identified, for a total of eight cases. Dr. Davis reported that the population of Northport and the surrounding area was relatively stable during the 1980s. He estimated that approximately 600 residents lived in the area, with approximately half in Northport itself and half in the surrounding areas. The 1990 United States Census reports 308 residents in the incorporated area of Northport. If an equal number live in the surrounding areas, his figure of 600 residents continues to be accurate.

The combined annual incidence of UC and CD is estimated at 5 to 15 cases per 100,000[6]. Based on 600 people living in the area per year, 0.7 to 2.1 new cases of UC and CD would be expected in the Northport area between 1970 and 1992. The eight observed cases are 3.8 to 11.4 times the expected number of cases.[7]

Public health traditionally emphasizes prevention of disease by eliminating exposure to known causes of disease. In some instances, identification of a new cause of disease is possible, especially where there are new exposures or where there have been few previous attempts to identify risk factors for the disease. Unfortunately, the causes of UC and CD remain unknown, although, extensive work has been done to isolate both environmental and non-environmental causes. Additionally, while there are a diversity of potential exposures in Northport, no unusual or rare contaminants have yet been identified.

However, DOH believes that because cases are continuing to arise and because there is a large array of potential exposures, Northport may offer a unique opportunity for discovering the cause of UC and CD. To this end, Dr. Boyko, who is an internist at the Veteran's Administration Medical Center in Seattle and an Associate Professor of Medicine at the University of Washington, has agreed to review DOH's summaries of UC and CD in Northport. If he believes that research into the etiology of these diseases in Northport might be fruitful, options for research projects will be explored. The Enteric Disease Branch of the National Centers for Disease Control and Prevention (CDC) will also be contacted to seek advice about research options.

Because of the preponderance of metals in the Northport area, Dr. Davis has suggested that UC and CD as contributing causes of death be explored in relation to occupation. This suggestion will be explored with DOH's Office of Epidemiology.

---

[6] Calkins, BM and Mendelhoff, AI. Epidemiology of inflammatory bowel disease. *American Journal of Epidemiology, 8*:60-91, 1986.

[7]
1) 1970-1992 is 23 years
2) 23 years * 600 people = 13800 person-years
3) With 5 to 15 cases/100,000 as the background rate, the expected number of cases in Northport is:
   (13800person-years/100000persons) * 5 expected cases = 0.69 expected cases
   (13800person-years/100000persons) * 15 expected cases = 2.07 expected cases
4) 8 observed cases/2.1 expected cases = 3.8
   8 observed cases/0.7 expected cases = 11.4

4. *Follow-up on thyroid cases:*
   a. obtain medical records to confirm diagnosis;
   b. geographic mapping and rate determination.

In September, DOH mailed questionnaires and release of information forms to 21 people who were reported to suffer from thyroid disease. Since the initial response rate was low, follow-up phone calls were made and additional records have been collected. These records were reviewed by the registered nurse and they are awaiting review by the epidemiologist.

5. *Follow-up on selected peripheral neuropathies to ascertain possible exposure to environmental contaminants.*

Because of the associations of peripheral neuropathies with heavy metal exposure, especially arsenic, DOH discussed testing of private well water in Northport with the Northeast Tri-County Health District. The health district reported that new wells are routinely tested for lead and arsenic. Twenty-eight wells have been tested in Stevens County townships which include Colville and north to the Canadian border (townships 36 through 40). Eleven of these wells were in townships 38, 39, and 40 which encompass the northern sections of this area, including Northport. Since neither lead nor arsenic have been found in any of these wells and since the program to test new wells will continue, it was decided that additional testing was not necessary.

At the May 1992 public meeting, three individuals were reported to have similar symptoms of peripheral neuropathy. Staff from DOH were unable to contact one of the individuals. Testing results from two of the individuals do not indicate local environmental exposures. In one case, symptoms are no longer present.

Unless requested by the individuals involved, DOH will not investigate these cases further.

Toxicological Review

6. *Conduct literature review of goitrogens in water.*

Goitrogen in water were discussed in the November report. This issue will not receive further consideration unless a review of the medical records indicates an excess of thyroid disease. (See number 4 above).

7. *Review list of suspected pollutants for links with reported disease.*

Review Of Radiation Impacts From Heavy Water Production Facility In Trail, British Columbia, During World War II

Background information on the Manhattan project at the Warfield site of the Cominco plant outside of Trail, British Columbia was forwarded to DOH by Graham Kenyon of the Environmental and Health Office of Cominco Metals. These documents were reviewed by

DOH, Division of Radiation Protection. The conclusions of DOH's review follow.

The documents concern deuterium (D), particularly in the form of heavy water (D_2O). These documents deal with deuterium's abundance, properties, and health effects, and with the production of heavy water.

The Warfield site at the Cominco plant that separated deuterium from hydrogen (H) ran for several years at the end of World War II. The adjoining electrolytic hydrogen facility closed in the 1960s.

The process used at Cominco did not involve radioactive material and apparently did not involve the addition of chemicals to the feed stock water. Only water, hydrogen gas, catalytic separators, and electricity were used in the process.

The source of hydrogen gas and electricity necessary for the operation was a pre-existing facility which used hydrogen to produce ammonia. The availability of hydrogen gas and electricity from an existing source drove the decision to build the facility at Cominco. The abundance of deuterium at the site was actually slightly lower than average.

When very large amounts (30 percent) of hydrogen in bodily fluids are replaced with deuterium, negative health effects occur. This would occur only as the result of an accidental release of heavy water. There would have been no source of concentrated heavy water after World War II, since the facility was closed after the war. There is no mention in the literature of health effects related to small doses, or chronic exposure.

There are no indications to link heavy water extraction with current health problems in the Northport area.

Air, Soil, and Biological Sampling

8. *Nominate Northport as one of the sites targeted in the lead soil sampling project.*

DOH has sent a Memorandum of Understanding (MOU) to the Northeast Tri-County Health District for their approval. The MOU outlines the roles and responsibilities of DOH and the health district for environmental lead sampling at elementary schools and day care centers in the in the health district area. The program is voluntary and to date, only Northport Elementary School has indicated a desire to participate. Onion Creek Elementary School is considering participation. This is an U.S. Environmental Protection Agency funded program. The goal of the project is to assess levels of lead in water, paint, indoor dust, and outdoor soil in potentially contaminated public areas. Sampling is scheduled to begin in May. Depending on testing results, appropriate follow-up will be recommended.

9. *Work to obtain funding for blood lead testing in children ages 1 to 3 residing in Northport and areas north of Northport.*

Northeast Tri-County Health District, in collaboration with DOH, organized a blood lead and mercury screening clinic for up to 90 children, ages 1 to 3 in the Northport and Onion Creek school districts. The health district advertised the clinic, arranged the location and scheduling, and staffed the clinic during the blood drawing. DOH provided technical assistance, arranged the hiring of a specialist in child phlebotomy, and selected the laboratory to analyze the samples.

Blood samples were drawn from 22 children. Nineteen children were between 1 and 3 years old, two were 4 years old and one was 5 years old. None of the children had blood lead level above 10 micrograms per deciliter (mcg/dL), indicating that at the time of sampling, in mid-December, there were no children tested who had significant environmental exposure(s) resulting in elevated blood lead. However, several of the children had measurable levels of blood lead, indicating that there may be environmental lead exposures.

At the community level, there is concern for two reasons. First, according to the CDC, if the primary source of lead exposure is the soil, blood lead levels will be the highest during the summer and early fall months. Since funding constraints necessitated sampling before July, it was decided that December was the best option, and results would be reviewed with the understanding that blood lead may have fallen from peak levels.

Secondly, only a small portion of those eligible for testing participated in the program. Therefore, those at highest risk for elevated blood lead levels may not have been reached.

Given the above concerns, DOH recommends that another assessment of blood lead in children be scheduled for July, August, or September if a plan for more complete participation can be devised and if funds for such a program can be located. DOH and Northeast Tri-County Health District believe that with active community involvement an effective plan for more complete participation can be devised.

Blood mercury levels were all below 2 mcg/dL, indicating that these children have not been exposed to environmental mercury.

10. *Obtain Manganese blood and urine data from the Spokane area physician and assess the need for additional testing.*

The physician was sent a letter requesting laboratory information related to manganese blood and urine screening be shared with DOH. The physician and DOH are currently discussing what information DOH would like and how this can be shared while maintaining patient confidentiality.

In relation to concerns about manganese in Kettle Falls, in October 1992, the National Institute of Occupational Health (NIOSH) inspected and sampled the workplace environment for manganese at the Boise Cascade Corporation (BBC) plywood plant in Kettle Falls.

NIOSH is presently interpreting the data and is considering a return visit to the BBC plant before finalizing its report. DOH has requested a copy of their report when it is available.

11. *Collaborate with Washington State Department of Ecology (Ecology) in ambient air monitoring activities.*

AIR QUALITY STUDY CONDUCTED IN NORTHPORT AREA

Ecology conducted an air monitoring study from December 15, 1992 to February 14, 1993, to determine the concentration of heavy metals in the area.

Three monitors were set up two, in Northport and one in Kettle Falls. The samplers collect "particulate" (small particles). Approximately 100 representative samples were collected and are being analyzed for lead and other metals.

DOH is awaiting the report of quality controlled laboratory data from Ecology. DOH expects to receive the data in April 1993. The data will be reviewed by the DOH, air quality program technical support toxicologist to determining its significance for health implications.

ADDENDUM

DEPARTMENT OF HEALTH
Office of Toxic Substances

April 29, 1993

TO: Kim Field

FROM: David F. Nash

SUBJECT: NORTHPORT SITE INVESTIGATION, OCTOBER 22-27, 1992

Introduction

This document is the report of my site investigation of the Northport area during the period October 22-27, 1992. Site visits were conducted primarily in the town of Northport, portions of Deep Creek and Onion Creek drainage systems, and an area east of Big Sheep Creek near the Columbia River. Without the assistance of local citizens, my visit would not have been a success.

In November 1992, a draft report of my investigation was submitted to staff for review. Because the draft report required follow-up investigation, it was not completed in time to be included with the document, *Evaluation of Health Concerns In Areas Of Northeast Tri-County*, dated November 30, 1992.

The recommendations in this report are the same as those in the November draft report. Even though portions of the recommendations were completed prior to the conclusion of my investigation, it was decided the recommendations, as listed in the draft report, should be a part of my evaluation.

Mining Activity

According to the Department of Natural Resources (DNR), northeastern Washington, including the Northport area of Stevens County is abundant with variable grades of lead and zinc ores. Other metals found in these ores are commonly copper, cobalt, silver, and gold.

DNR has listed on their data base approximately 40 mines which are located in the Northport area. Many of these mines operated only for a short period of time or inconsistently through the years. The Van Stone Mine, near Onion Creek, is the only known operating lead and zinc mine in the Northport area. Other mines that have operated in the past are Black Rock (Maki) Mine and Deep Creek Mine on Deep Creek, Blue Ridge Mine on the South Fork of Deep Creek, Anderson Mine at Leadpoint and Iriquois Mine east of Cedar Lake.

The most common method of concentrating lead and zinc ores is by flotation - a process of pulverizing the ore to fine sand size particles, transporting the pulverized ore to flotation cells and using chemicals to clean and float the metal bearing particles to the surface of the cells. The metal bearing particles or concentrate is then skimmed from the surface of the cells, dried, and shipped to the smelter for refining. Some of the chemicals used for concentrating lead and zinc ores are sulfuric acid, lime, higher alcohols, coaltar oils, and copper sulfate. The waste materials, known as mill tailings, are generally stored on site and contain less than 1 percent lead and zinc.

Beginning in 1897, the Northport smelter refined lead, copper, and silver ores from mines in northeastern Washington, as well as copper ore from British Columbia. In 1922, after 24 years of sporadic operation, the smelter closed and was dismantled. Concentrates from the operating Van Stone Mine are shipped to the Cominco smelter in Trail, B.C.

Water Quality

Until the late 1960s, when construction of the present drinking water wells began, the primary water supply for the Town of Northport was a surface diversion from Deep Creek. The wells are of similar depth and construction and are located on the smelter property. Current chemical analyses meet drinking water standards for the state of Washington (from Washington State Department of Health, Division of Drinking Water).

For some rural families living in the Deep Creek, Deep Lake, Cedar Creek, and Onion Creek areas, surface water may still be used as a source of drinking water. Ground water, however, is the primary source. Little data is available about rural surface and groundwater quality. In 1968, water samples were collected from the Deep Creek drainage system and analyzed for lead. Sixty parts per billion (ppb) were found in Smackout Creek and 40 ppb were found in Deep Creek near Northport.

In 1989, ground water samples were collected from two domestic drinking water wells north of Northport and analyzed for heavy metals. The concentration of the heavy metals met the state drinking water standards. Several children in the two families using these domestic wells have been diagnosed with inflammatory bowel disease.

During their youth, the above children swam in an intermittent pool located in an elevated area of the Columbia River channel. The depth of the pool fluctuated with the depth of the river. Occasionally toilet paper and other human wastes were found in the pool.

Other pollution in the Columbia River is not uncommon. On October 18, 1992, citizens reported seeing large pieces of "foam" floating on the river. Also, in October 1992, Cominco reported an uncontrolled release of metallic mercury into the Columbia River.

There also have been reports that a domestic well near Big Sheep Creek is contaminated with mercury. According to the owner, analysis of a water sample taken several years ago did not detect mercury but he still advised renters not to drink the water.

Residents reported that mining exploration divers, in the fall of 1992, found a pool(s) of metallic mercury in sediments in the mouth of Big Sheep Creek. Coincidentally, and at the same time as the divers, the United States Geological Survey (USGS) and the Washington State Department of Ecology (Ecology) were also conducting activities in the area. Examination of sediments in the mouth of Big Sheep Creek by USGS did not confirm any pool(s) of metallic mercury in the sediments. However, USGS did find mercury (physical state not known) in the particulate portion of suspended sediment samples taken in the Columbia River downstream from Big Sheep Creek. Mercury was not detected in the water portion of these samples (from USGS). In their studies of the upper Columbia River, Ecology has also found mercury (physical state not known) and other heavy metals in sediments (from Ecology). It is believed that metallic mercury found in Big Sheep Creek may have come from historical placer mining, however, mercury as well as other heavy metals may also have come from industrial discharges into the Columbia River.

Air Quality

According to residents, several times a month, a plume of smoke flows south from Canada, intersects the Columbia River south of the Pend Orielle River, abruptly flows northeast and settles in the Cedar Creek area. The last reported plume was on October 19, 1992. The residents complained of headache, burning eyes and throat, and a "sulfur" odor. The plumes are reported to be diluted or non existent when they reach the Town of Northport. Occasionally, weather conditions produce inversions in the Northport valley, causing entrapment of industrial pollutants and smoke from wood burning stoves.

Cattle Illnesses

In 1983, health problems in cattle grazing near Leadpoint prompted an investigation by the Washington State University, College of Veterinarian Medicine. The cattle were diagnosed with copper deficiency. The deficiency was caused by high soil molybdenum which increased the molybdenum/copper ratio and resulted in poor absorption of copper by the cattle. The health problems were corrected with copper supplements.

In the fall of 1992, several cattle died while grazing in a field near Leadpoint. Even after considerable investigation, the cause of these deaths was not determined (from Stevens County Extension Office).

Discussion

In general, exposure of the population to mining contaminants would be expected to be less at the present time than in the past, when numerous operations were active.

However, individuals who inhale dust and contaminate clothing and vehicles when visiting, driving through or living in areas of past mining activities may increase their exposure to the contaminants.

Heavy metals and other contaminants released by the Northport smelter would have been deposited on the town of Northport and neighboring areas. During the operating period of the smelter, soil concentrations of the contaminants would steadily increase. Children and adults who presently play or work in the soil can be exposed to the contaminants.

The Van Stone Mine is a potential source of heavy metal exposure to children and adults who live in the vicinity. One of their tailing ponds is located within a short distance from the Onion Creek School. In addition, airborne contaminated dust created from trucks hauling concentrates and other vehicles using the mining road are potential sources of exposure.

As yet to be confirmed, a major source of air pollution, according to residents in the Cedar Creek area is from the Cominco smelter in Trail, B.C.

There is a potential for surface and ground waters to be contaminated from the leaching of discarded ores and mill tailing pond materials, and/or industrial discharges.

Recommendations

1. Continue with the proposed blood lead and mercury sampling of children in the Northport and Onion Creek School Districts.

2. In consultation with affected residents, sample the air in the Cedar Creek area for heavy metals, sulfur dioxide, and other contaminants that may be released from a smelter. In order to obtain satisfactory results, sampling should occur over a sufficient period of time to encounter a series of plumes.

3. Depending upon the results of 1 and/or 2, other environmental sampling may be recommended.

ADDENDUM 2

ADDENDUM

ANALYSIS OF NORTHPORT DATA

The following analysis has been performed on air monitoring data collected for the period starting December 18, 1992 and ending February 14, 1993 in the Northport/Kettle Falls area.

To provide some perspective of the measured level of lead and arsenic obtained at Northport, data from three maximum lead (Pb) and arsenic (As) sites in the state have been provided for comparison. The three monitoring sites are:

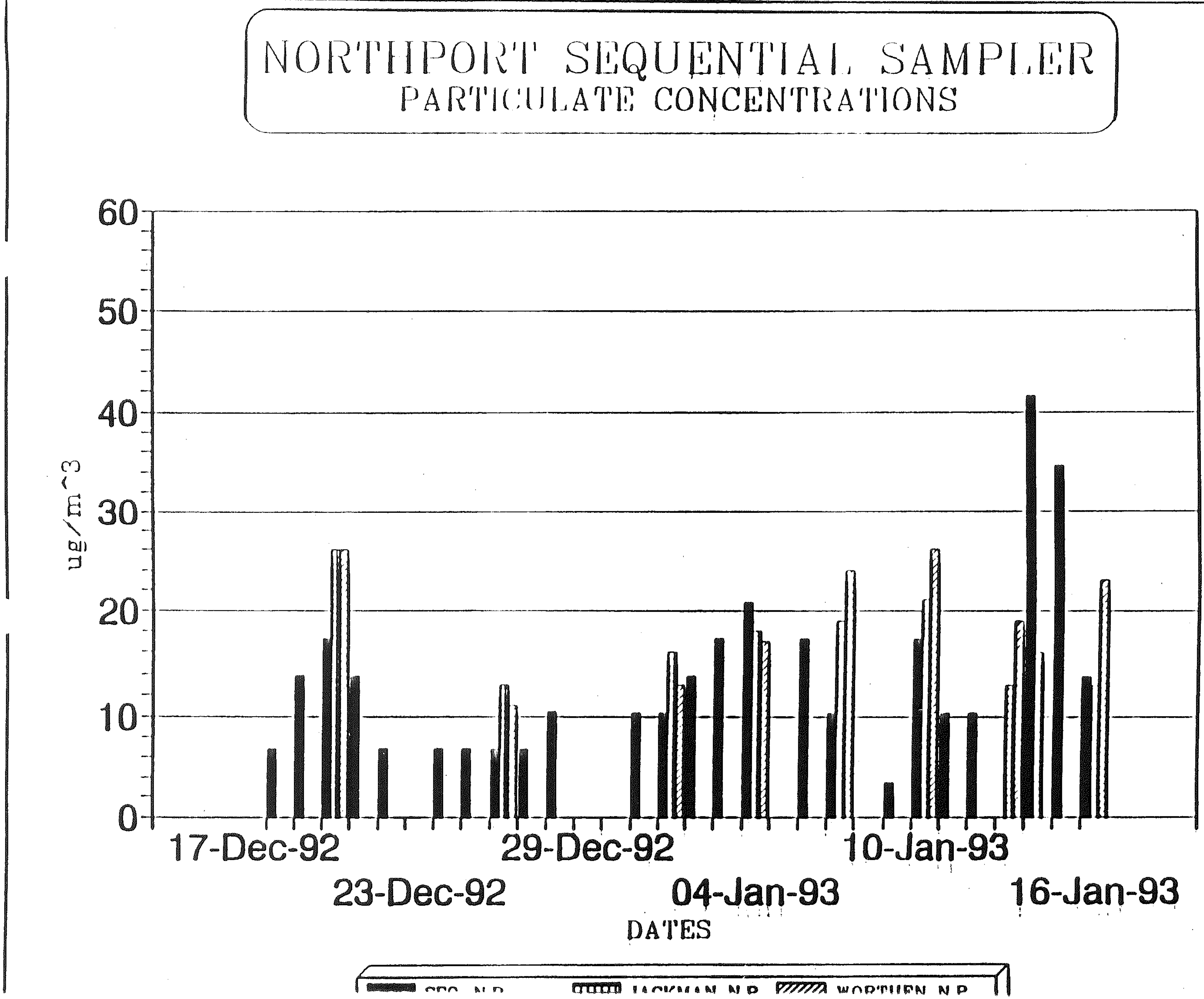
1. Seattle LDS Church-just off I-5 near U of W (Pb)
2. Seattle Harbor Island-Texaco near Spokane St. and Harbor Is. (Pb)
3. Tacoma Ruston School-near the old ASARCO smelter (Pb,As)

No direct relationship was found to exists between high particulate levels (total suspended particulate-TSP) and high lead or arsenic levels. Lead levels at the LDS Church site (located to show trend data from auto emissions as lead was phased out of gasoline), are 1/10 those at the Harbor Island site (located near a lead processing smelter). The lead levels at the Ruston School are 1/20 those of the Harbor Island site. The lead levels at Northport compared with the annual average at Harbor Island, indicates that Northport is slightly higher. The present National Ambient Air Quality Standard for lead is 1.5 micrograms per cubic meter (ug/ M^3) quarterly average. The national medium suburban maximum background levels are less than 0.1 ug/M^3. Northport has significantly higher level than the background level. The Worthen monitoring site averaged 0.92 ug/M^3 for the study period.

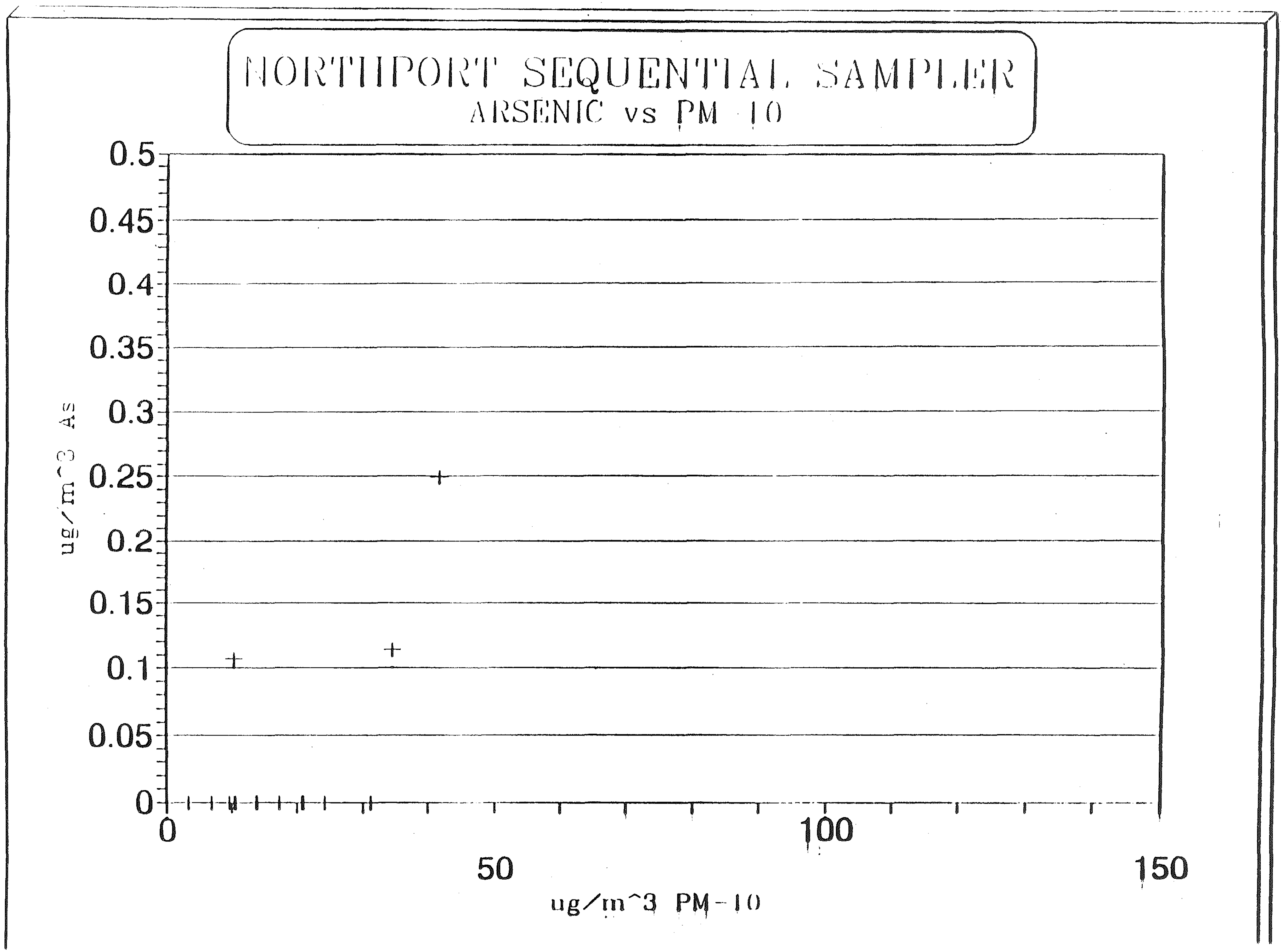
Arsenic levels were measured at the Tacoma Ruston School from 1990 thru June 1991. The annual arsenic levels of 0.02 ug/M^3 recorded at Ruston School is 100 times that recommended as the safe level of 0.00023 ug/M^3. The overall arsenic levels measured at Northport averaged 0.039 or nearly double the annual average measured at the Ruston School site.

Peak daily values for both lead and arsenic at the Northport sites reached 1.91 and 0.21 ug/M^3 respectively. Peak daily lead values at Harbor Island reached 0.67 ug/M^3 and arsenic values at Ruston School reached 0.04 ug/M^3. What meaning this may have is not clear, but there is definite differences in levels between the various monitored sites in the Northport area.

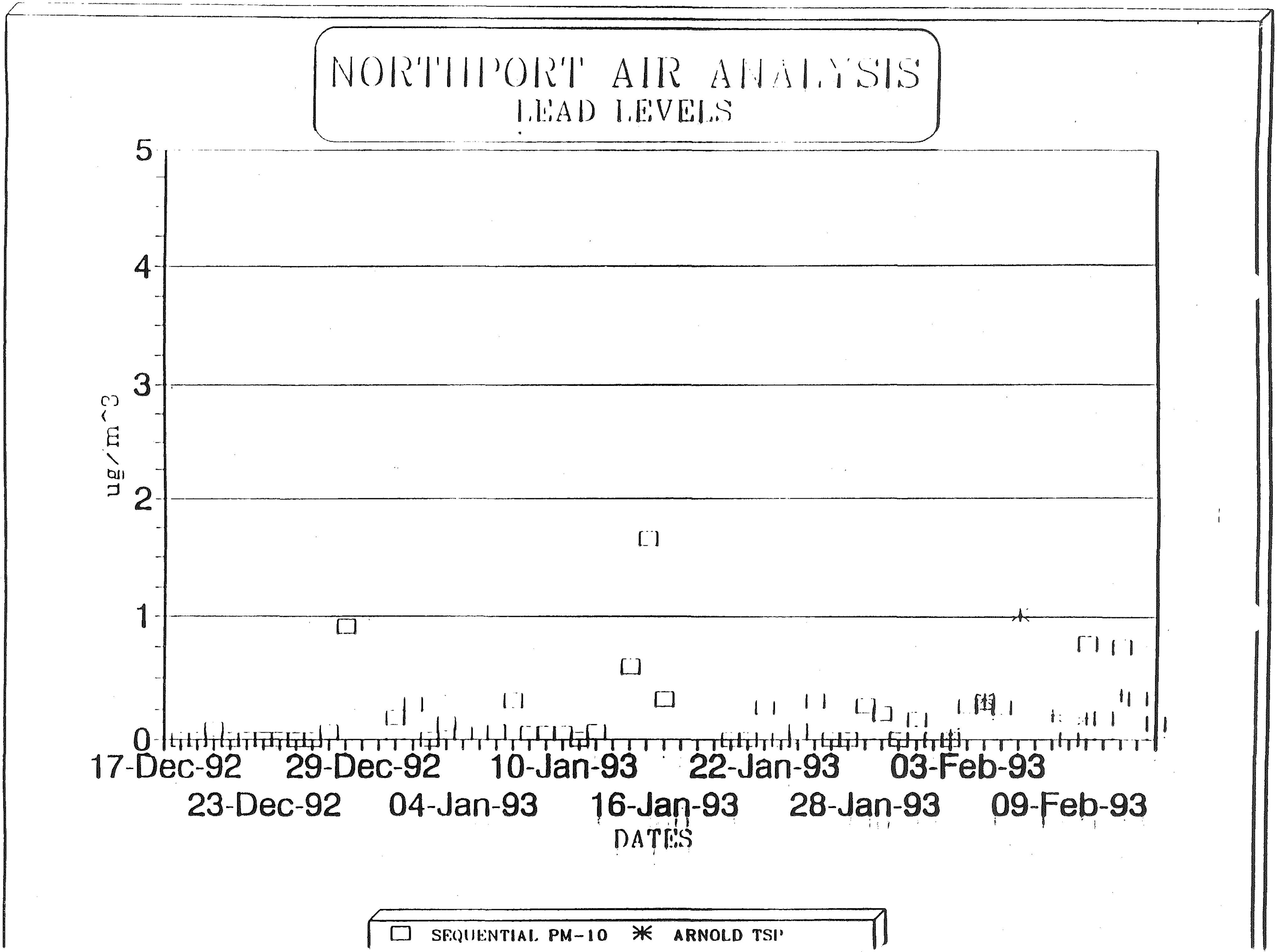
NORTHPORT
PARTICULATE PLOTS


NORTHPORT SEQUENTIAL SAMPLER
PARTICULATE CONCENTRATIONS
60
50
40
30
20
10
0
ug/m^3
17-Dec-92
23-Dec-92
29-Dec-92
04-Jan-93
10-Jan-93
16-Jan-93
DATES

NORTHPORT
ARSENIC PLOTS

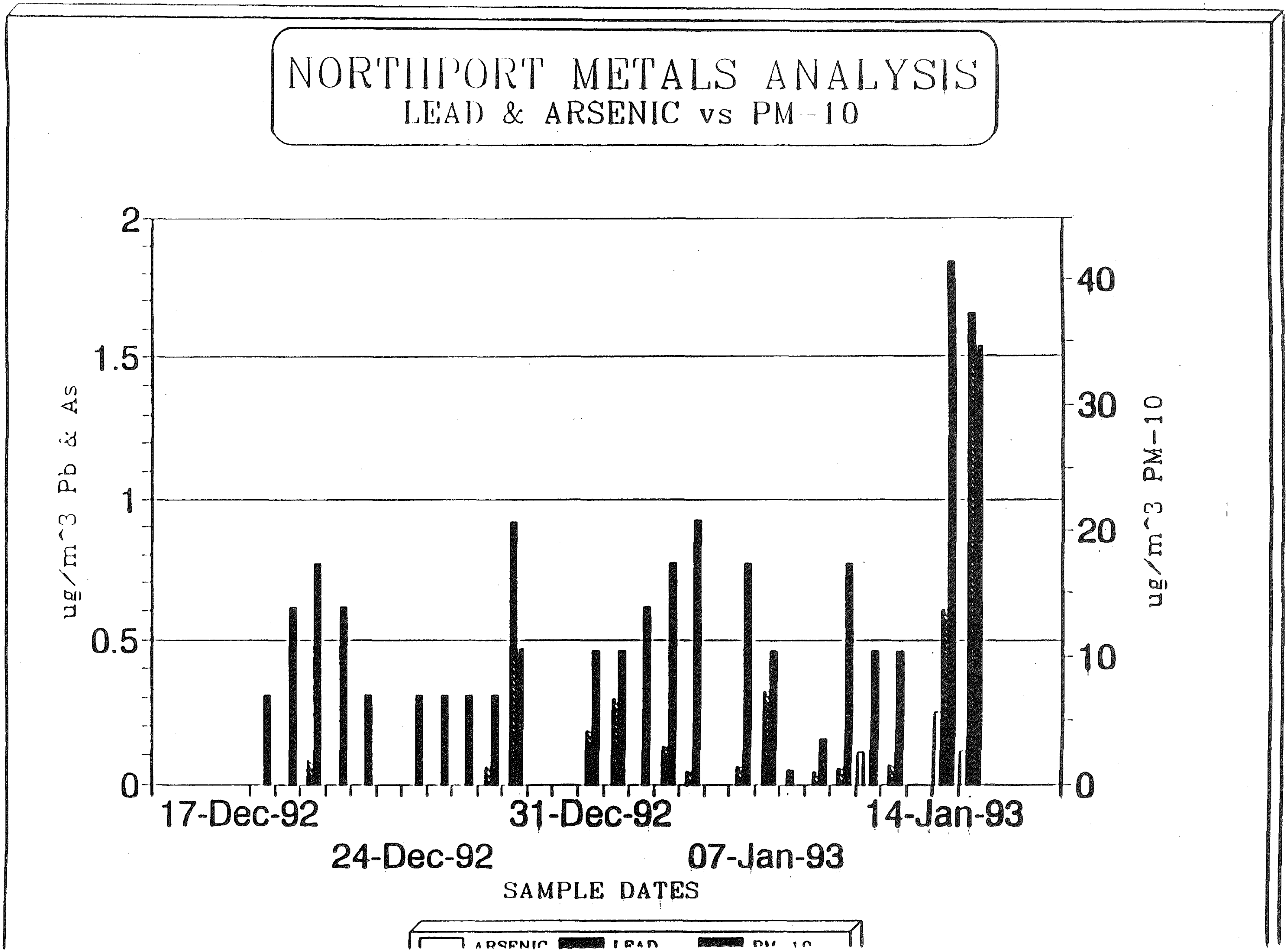

NORTHPORT SEQUENTIAL SAMPLER
ARSENIC vs PM-10
ug/m^3 As
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
50
100
150
ug/m^3 PM-10

NORTHPORT
LEAD PLOTS


NORTHPORT AIR ANALYSIS
LEAD LEVELS
ug/m^3
5
4
3
2
1
0
17-Dec-92
23-Dec-92
29-Dec-92
04-Jan-93
10-Jan-93
16-Jan-93
22-Jan-93
28-Jan-93
03-Feb-93
09-Feb-93
DATES
SEQUENTIAL PM-10
ARNOLD TSP

NORTHPORT

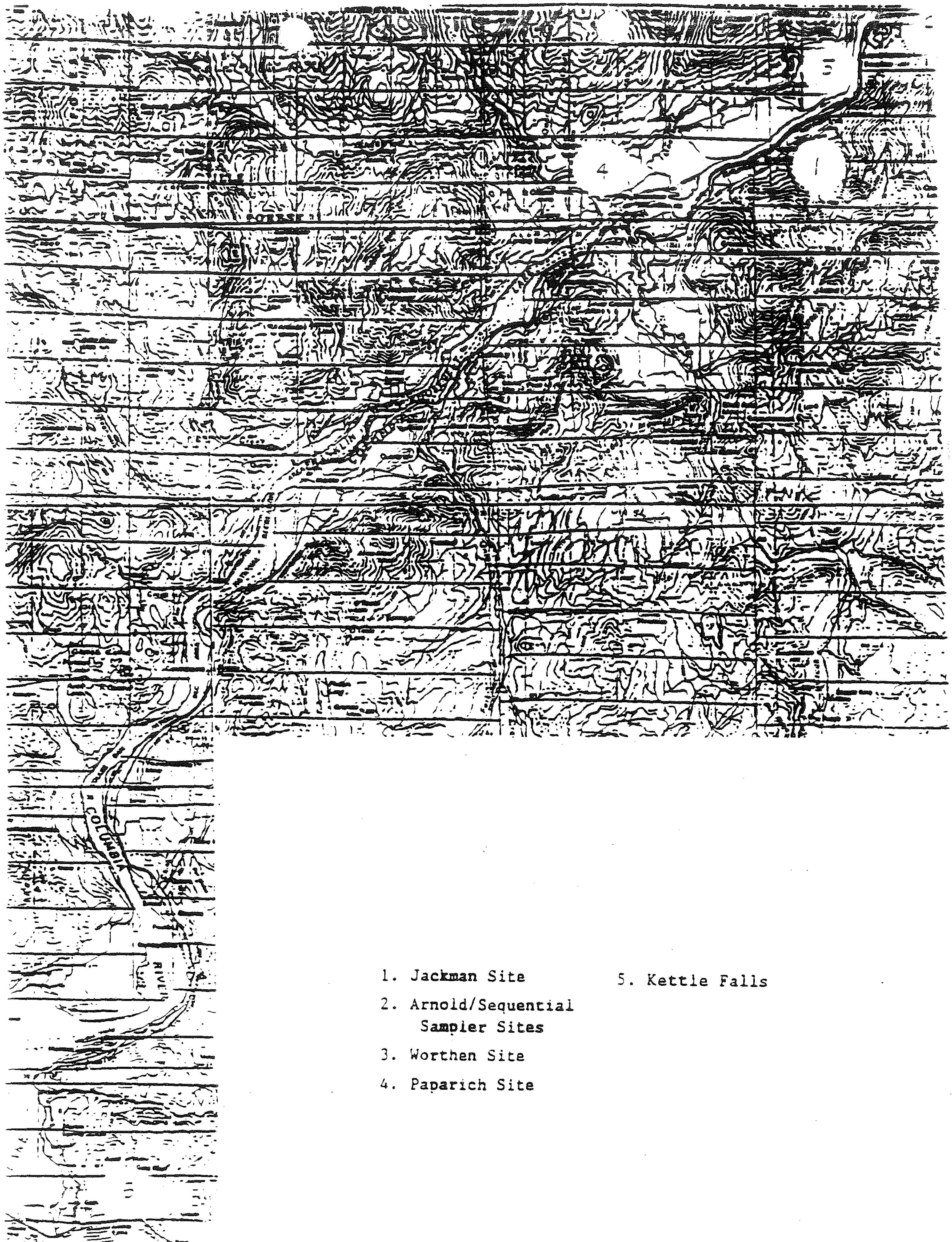
METAL/LEAD/ARSENIC
PLOTS

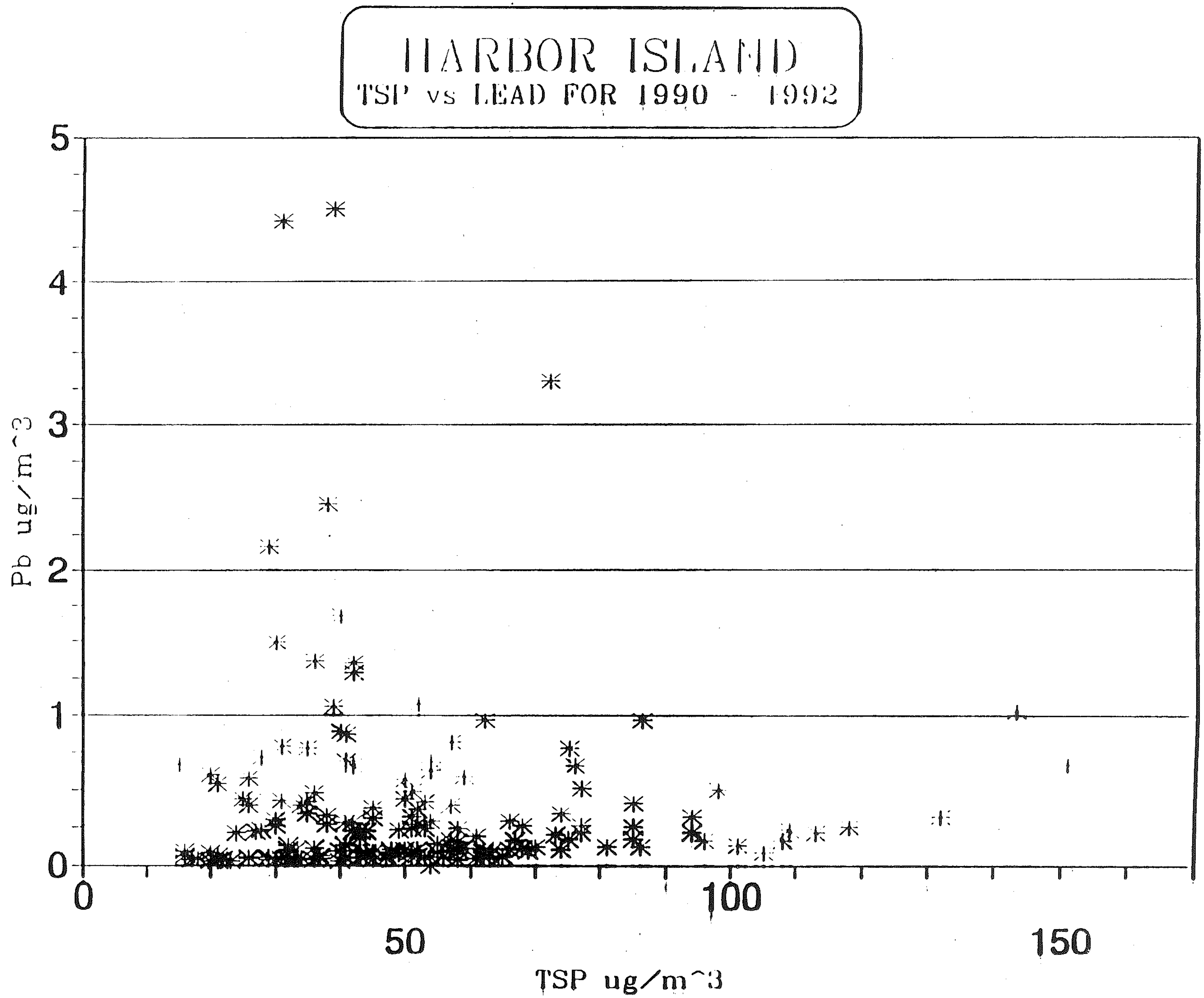


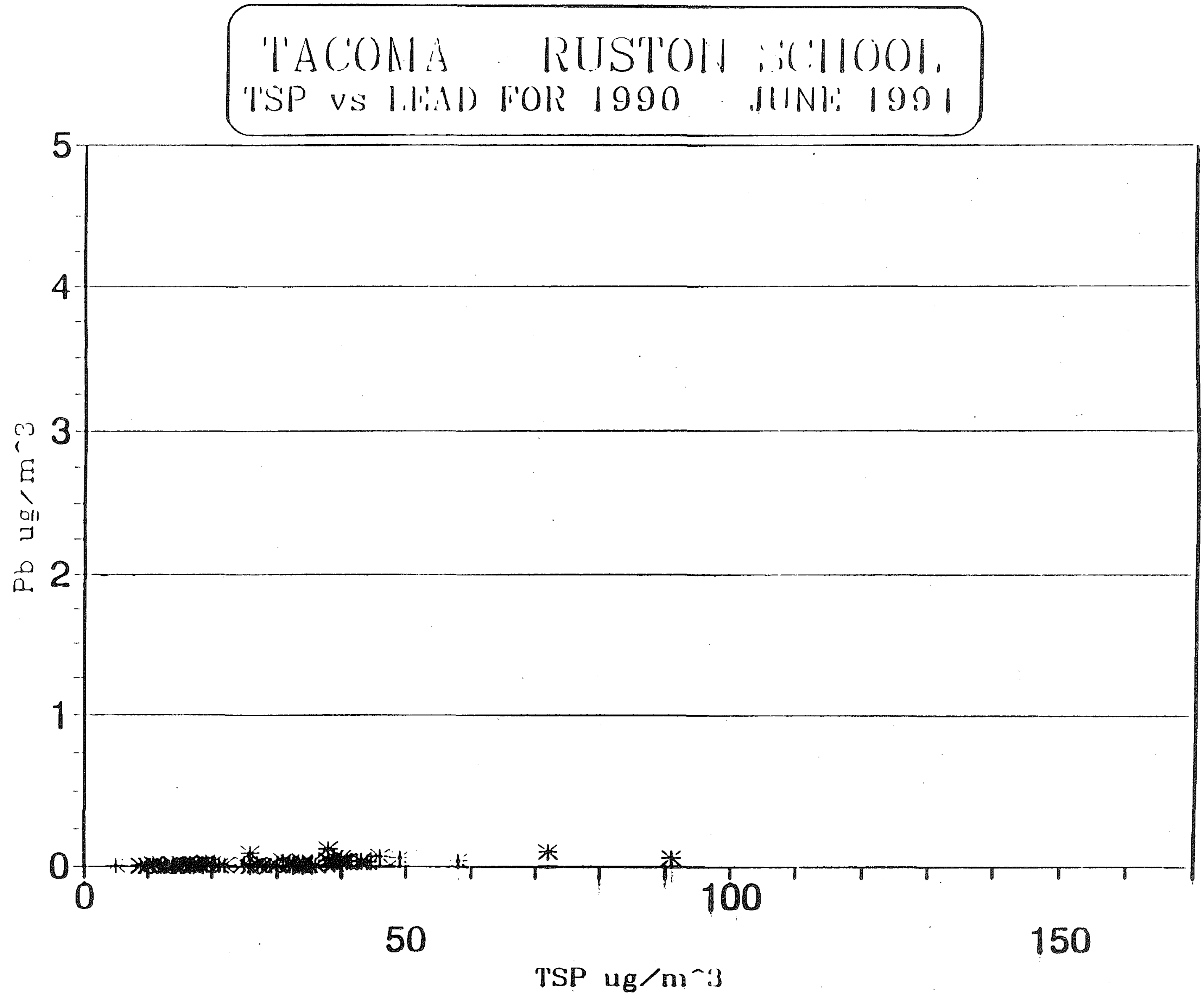
NORTHPORT METALS ANALYSIS
LEAD & ARSENIC vs PM-10
ug/m^3 Pb & As
ug/m^3 PM-10
0
0.5
1
1.5
2
0
10
20
30
40
17-Dec-92
24-Dec-92
31-Dec-92
07-Jan-93
14-Jan-93
SAMPLE DATES
ARSENIC
LEAD

NORTHPORT PARTICULATE STUDY: DEC. '92 – FEB. '93

Date	SEQUENTIAL SAMPLER			ARNOLD - NORTHPORT			PAPARICH - NORTHPORT			JACKMAN - NORTHPORT			WORTHEN - NORTHPORT			KETTLE FALLS		
	PM-10 (ug/m^3)	Lead ug/m^3	Arsenic ug/m^3	TSP ug/m^3	LEAD ug/m^3	AS ug/m^3	TSP ug/m^3	LEAD ug/m^3	AS ug/m^3	TSP ug/m^3	LEAD ug/m^3	AS ug/m^3	TSP ug/m^3	LEAD ug/m^3	AS ug/m^3	TSP ug/m^3	LEAD ug/m^3	AS ug/m^3
18 Dec 92	6.92	0.0000	0.0000															
19 Dec 92	13.84	0.0000	0.0000															
20 Dec 92	17.30	0.0830	0.0000				10	0.3544847	0.0601671	26	0.7292007	0.1123612	26	0.5803366	0.1118314			
21 Dec 92	13.84	0.0000	0.0000															
22 Dec 92	6.92	0.0000	0.0000															
23 Dec 92	0.00	0.0000	0.0000															
24 Dec 92	6.91	0.0000	0.0000															
25 Dec 92	6.92	0.0000	0.0000															
26 Dec 92	6.92	0.0000	0.0000				12			13			11	0.0152629	0			
27 Dec 92	6.92	0.0588	0.0000															
28 Dec 92	10.55	0.9183	0.0000															
29 Dec 92																		
30 Dec 92	0.00																	
31 Dec 92	10.38	0.1834	0.0000															
01 Jan 93	10.38	0.2942	0.0000				9	0.4873096	0	16	0.2656538	0	13	0.4235294	0	15	0.043	0
02 Jan 93	13.84	0.0000	0.0000															
03 Jan 93	17.29	0.1200	0.0000															
04 Jan 93	20.76	0.0450	0.0000				17	0.4689280	0.0262479	18	0.6659066	0.030843	17	0.5337812	0.0362764			
05 Jan 93																9	0	0
06 Jan 93	17.30	0.0588	0.0000															
07 Jan 93	10.38	0.3219	0.0000				23	1.6818182	0.0606061	19	1.3634872	0.0488865	24	1.0877551	0.0663265	34	0.400274	0.017232
08 Jan 93	0.00	0.0485	0.0000															
09 Jan 93	3.46	0.0450	0.0000															
10 Jan 93	17.31	0.0519	0.0000							21	0.9370933	0.0976139	26	1.1626062	0.2105949	17	0.343738	0.023662
11 Jan 93	10.38	0.0000	0.1073															
12 Jan 93	10.38	0.0623	0.0000															
13 Jan 93	0.00						21			13	0.7747699	0.0331348	19	1.1624365	0.0467005	14	0.439168	0
14 Jan 93	41.55	0.6025	0.2493							16	1.2256542	0.0478368						
15 Jan 93	34.62	1.6551	0.1143															
16 Jan 93	13.85	0.3324	0.0000				22	0.2161616	0.0217172	13	0.3616594	0.0439262	23	1.176503	0.1092113	22	0.201348	0
17 Jan 93	0.00																	
18 Jan 93	0.00																	
19 Jan 93	0.00									11	0.2292776	0.0171103	17	0.2106061	0.0176768	13	0.044286	0
20 Jan 93	9.71	0.0000	0.0000															
21 Jan 93	0.00	0.0000	0.0000															
22 Jan 93	3.46	0.2676	0.0000				6	0.010645	0									
23 Jan 93	10.38	0.0000	0.0000							5	0.1464324	0						
24 Jan 93	24.22	0.0727	0.0000															
25 Jan 93	0.00	0.3289	0.0000				26	2.1646859	0.0916808	18	1.9076087	0.1076087	34	2.2095184	0.1070822	17	0.06809	0
26 Jan 93	13.83	0.0000	0.0000															
27 Jan 93	0.00	0.0000	0.0000															
28 Jan 93	6.92	0.2780	0.0000				18	0.165855	0.0796901									
29 Jan 93	10.39	0.2181	0.0000															
30 Jan 93	0.00	0.0000	0.0000							9	0.0078525	0						
31 Jan 93	6.92	0.1731	0.0000				12	0.2947939	0.0405098	15	0.6003254	0.0780911	34	0.5144312	0.0611205	18	0.011026	0
01 Feb 93	6.92	0.0000	0.0000															
02 Feb 93	3.46	0.0000	0.0000	12	0.041538	0												
03 Feb 93	3.46	0.2800	0.0000							14	0.3448052	0.0321429	18	0.5443754	0.0508762			
04 Feb 93	6.92	0.3116	0.0000	16	0.339725	0.025714												
05 Feb 93	13.83	0.2718	0.0000				27	0.4803288	0.0433973									
06 Feb 93	0.00			36	1.02	0.093699				45	1.5467216	0.1186161	56	1.0101695	0.1423729	40		
07 Feb 93	0.00									34	1.3567945	0.0544255						
08 Feb 93	0.00			16	0.204231	0.028187	24	0.7525084	0.0366221				21	0.5312145	0.0439274			
09 Feb 93	13.79	0.0000	0.0000										31	1.5536669	0.1728773			
10 Feb 93	13.83	0.7814	0.0000	20	0.183060	0.016822	31	0.6410959	0.0739726	29	0.1328595	0						
11 Feb 93	21.01	0.1821	0.0000										37	1.1231029	0.1112985			
12 Feb 93	31.14	0.7590	0.0000	27	0.378247	0.032548				31	0.7574751	0.0647841				27		
13 Feb 93	24.22	0.3460	0.0000				15	0.1433278	0	11	0.0456683	0	18	0.1123094	0			
14 Feb 93	6.92	0.1380	0.0000	20	0.019233	0												


COLUMBIA
1. Jackman Site
2. Arnold/Sequential Sampler Sites
3. Worthen Site
4. Paparich Site
5. Kettle Falls


HARBOR ISLAND
TSP vs LEAD FOR 1990 - 1992
Pb ug/m^3
TSP ug/m^3
0
1
2
3
4
5
0
50
100
150


TACOMA RUSTON SCHOOL
TSP vs LEAD FOR 1990 JUNE 1991
5
4
3
2
1
0
Pb ug/m^3
0
50
100
150
TSP ug/m^3

NORTHPORT AIR QUALITY STUDIES
July 1993 - December 1993

This study is designed to answer two questions:

- What are the air pollution sources of particulate (PM10) and selected heavy metals, such as lead, that could cause health effects?
- Where are maximum exposures to these pollutants most likely to occur?

ANTICIPATED STUDY SCHEDULE

July 93

- Identify potential sources of PM10 and heavy metals (i.e., As, Cd, Mn, Pb, Zn) in the Northport/Kettle Falls area. Conduct site investigations and collect source specific information necessary for development of a realistic inventory of possible sources of PM10 and heavy metals. Select significant sources for each pollutant of interest.
- Begin short term particulate sampling at 3 locations.
- Arrange with Cominco smelter and British Columbia Ministry of Environment for collection of Canadian air quality data.
- Develop sampling frequency for initial metals analysis.
- Operate Northport TSP site for lead.

August 93

- Evaluate existing studies and data or, if necessary, conduct screening modelling for dispersion/deposition of PM10 and heavy metals from significant Northport and Kettle Falls sources.
- Identify options for particulate/metals monitoring locations as dictated by inventory, modelling and previous sampling.
- Start and maintain records of monitoring and meteorological data from British Columbia; obtain pertinent, available, BC data on a regular basis.
- Install and begin operation of fixed sampling sites for particulate, metals and meteorological data.
- Establish 2 or 3 portable PM10 sampling sites.

KRISTINE GEBBIE
Secretary

Ouvi
PS -> Kim
Thanks

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
OFFICE OF TOXIC SUBSTANCES
Airdustrial Center, Building 4 • P.O. Box 47825 • Olympia, Washington 98504-7825

November 30, 1992

TO: Northeast Tri-County Health District and Interested Citizens

FROM: Kim Field, Public Health Advisor
Environmental Health Assessment Section

SUBJECT: Evaluation of Health Concerns In Areas of Northeast Tri-County

---

The Washington State Department of Health (DOH) has prepared the attached summary of activities since the July 31, 1992, report to the community.

The July 1992 report summarized health concerns of the citizens of the Northport and Kettle Falls areas, possible sources of environmental contamination, and proposed activities to be undertaken by DOH between August 1992 and January 1993.

Included in this summary are three sections: Section 1) updates what DOH has done in relation to the activities proposed in the July report, Section 2) lists three proposals submitted by DOH for consideration by the Northeast Tri-County Health District, and Section 3) documents follow-up activities which have occurred in relation to the first proposal outlined in Section 2.

Northeast Tri-County Health District and DOH will proceed with proposal #1 at this time as outlined in Section 2.

A report to follow in February 1993 will include information derived from epidemiological and toxicological reviews as well as air and biological sampling.

If you need further information, please contact me at (206)586-6179.

Attachment

SECTION 1: ACTIVITIES OF DEPARTMENT OF HEALTH (DOH) IN RELATION TO ACTIVITIES PROPOSED IN THE JULY 1992 NORTHPORT REPORT

In the July report, proposed activities were divided into three areas, including epidemiologic reviews; toxicological reviews; and air, soil, and biological sampling. In the italicized text are the activities DOH proposed in the July report.

Epidemiologic Reviews

1. *Compare rates of cancer (particularly brain and colorectal cancers) mortality in Stevens County and Northport to rates for Washington State and the United States.*

   This activity has not been completed, DOH plans to address this issue by January 1993.

2. *Compare rates of hospitalizations for ulcerative colitis (UC) and Crohn's Disease (CD) for Stevens County and Northport to rates for selected control counties.*

   Initial computer runs have been made. Further work is necessary to complete the analysis. DOH intends to complete the analysis by January 1993.

3. *Follow up on unconfirmed cases of UC and CD:*
   a. obtain medical records to confirm diagnosis;
   b. geographic mapping and rate determination.

   In September, DOH mailed questionnaires and release of information forms to 18 people who were reported to suffer from UC or CD. A copy of the material sent to adults identified with UC or CD is included as Appendix A. Similar materials were provided for minors and next of kin respondents.

   As of October 30, 1992, only 4 of the 18 people contacted have returned the questionnaires and release forms. Due to the poor initial response, a strategy to obtain a more complete response needs to be formulated. Analysis of the data will be delayed until a more complete response is achieved.

4. *Follow up on thyroid cases:*
   a. obtain medical records to confirm diagnosis;
   b. geographic mapping and rate determination.

   In September, DOH mailed questionnaires and release of information forms to 21 people who were reported to suffer from thyroid disease (See Appendix A). As of October 30, 1992, 8 of these people have returned the material requested. Due to the poor initial response, a strategy to obtain a more complete response needs to be formulated. Analysis of the data will be delayed until a more complete response is achieved.

5. *Follow up on selected peripheral neuropathies to ascertain possible exposure to environmental contaminants.*

Persons with selected peripheral neuropathies were contacted in early October and a site visit was made during the third week of November. Information regarding biological testing for heavy metal exposure was obtained. Follow-up will continue to ascertain possible exposures, including which exposures have been ruled out by previous biological testing.

Toxicological Review

6. *Conduct literature review of goitrogens in water.*

After reviewing the literature on goitrogens in food and water, DOH has concluded that cobalt may be the most likely exposure. Cobalt interferes with iodine uptake by the thyroid (Kriss *et al.*, 1957), and epidemiologic studies suggest increased incidence of goiter in regions with relatively high levels of cobalt in water and soil (Goyer, 1991).

The Department of Natural Resources (DNR) lists cobalt as a commodity from the Deep Lake area. Additionally, cobalt is usually found with copper (Goyer, 1991), and DOH suspects that the Northport area has naturally occurring high levels of copper in the environment. DNR lists copper as a mining commodity from two mines in the area. In addition, at least three citizens have reported elevated levels of copper levels in biological samples. It should be noted that medical records of these individuals have not been obtained to: 1) rule out the presence of genetically inherited inborn errors of copper metabolism and 2) verify the presence of elevated levels of copper.

7. *Review list of suspected pollutants for links with reported disease.*

To date this review has focused on metals in the area. A summary of DOH's conclusions in this area is presented as proposals #2 and #3 in Section 2.

DOH has been unable to evaluate air pollutants due to the lack of air monitoring (see activity #11 below).

On page 8 of the July 1992 report, DOH indicated that we had been unable to locate information regarding "heavy water" production in the Northport area. DOH received a letter from Dr. Nelson Ames, Director/Medical Health Officer, Central Kootenay Health Unit, regarding this issue. Dr. Ames confirmed that "heavy water" was produced for the Manhattan project at the Warfield site of the Cominco plant just outside of Trail, British Columbia.

DOH has contacted representatives of Cominco in Trail, British Columbia, as well as the United States Department of Energy. At this time DOH has confirmed this location but has no further information regarding a potential source of environmental exposure related to this process. DOH will continue to seek information regarding this issue.

Air, Soil, and Biological Sampling

8. *Nominate Northport as one of the sites targeted in the lead soil sampling project.*

   DOH would like the Northport and Onion Creek elementary schools to be tested for environmental lead using grant monies provided through the United States Environmental Protection Agency (EPA) and administered by DOH. Unfortunately, one of the conditions of the grant is that DOH provide matching monies. DOH, in turn, requires that the local health districts provide a share of the matching money by allocating 50 to 100 hours of staff time to the project. DOH is currently negotiating with the Northeast Tri-County Health District to ascertain whether this level of local involvement is possible.

9. *Work to obtain funding for blood lead testing in children ages 1 to 3 residing in Northport and areas north of Northport.*

   DOH will provide partial funding for blood lead and mercury screening for up to 90 children ages 1 to 3 in the Northport and Onion Creek school districts. The remainder of the funding will come from the Northeast Tri-County Health District in the form of staff time required to plan and implement a screening program. The rationale for this program is presented in Proposal #1 in Section 2. The proposed clinic dates for blood lead and mercury screening are December 16-18, 1992.

10. *Obtain Mn blood and urine data from the local physician and assess the need for additional testing.*

    The physician has not returned phone calls to discuss this issue. A formal letter will be sent requesting this information be shared with DOH.

11. *Collaborate with the Department of Ecology (Ecology) in ambient air monitoring activities.*

    DOH and Northeast Tri-County Health District have made a written request to Ecology for air sampling in the Northport area as soon as possible utilizing the mobile air monitoring van. Ecology staff will focus on total suspended particulate.

    Northport area residents report that plumes of smoke flow south from the Canadian border several times a month. According to residents, the plume intersects the Columbia River south of the Pend Orielle River, abruptly flows northeast and settles in the Cedar Creek area. Health effects complaints include headaches, burning eyes and throat, and an odor of sulfur.

SECTION 2: PROPOSALS SUBMITTED BY DOH FOR CONSIDERATION BY THE NORTHEAST TRI-COUNTIES HEALTH DISTRICT

Background

DOH and Northeast Tri-County Health District have discussed the three following proposals in respect to funding, availability of staff, and allocation of time.

At the October 26, 1992, meeting in Northport it was decided that both agencies could implement proposal #1 immediately. Proposal #2 and #3 need further consideration after medical records regarding inflammatory bowel disease and thyroid disease have been reviewed.

Proposals For Follow-up On Community Concerns In Northport

Northport is located eight miles south of the Canadian border on the east side of the Columbia River in Stevens County. For several years residents of the Northport area have been concerned about the prevalence of illness in their community. Health concerns include inflammatory bowel disease, cancer, thyroid disease, peripheral neuropathy, respiratory disease, and lead poisoning. DOH has reviewed the health concerns of the community and potential sources of environmental contamination. Based on this review, and cognizant of budget constraints, DOH proposes the following actions be taken as initial steps toward addressing some of the concerns raised by the community.

PROPOSAL #1: ASCERTAIN BLOOD LEVELS OF LEAD AND MERCURY IN CHILDREN

Background

Lead

Trail, British Columbia, is approximately 18 miles north of Northport. Trail is the home of the Cominco Smelter, which is the largest zinc-lead smelter in the world. Monitoring stations in Trail record airborne particulate lead levels which are 1.5 times as high as those found in the residential and industrial areas of Vancouver, British Columbia. This lead may be inhaled directly or it may be deposited in the soil where it can be ingested by young children. According to Dr. Ames of the Central Kootenay Health Unit, approximately 40 percent of the children in Trail have blood lead levels over 15 micrograms per deciliter (mcg/dL). Several children have blood lead levels above 25 mcg/dL.

Dr. Ames reported that soil lead levels are only elevated within six miles of the smelter. However, given that DOH has not been able to evaluate these studies and given that the residents of Northport report that the plume from Cominco reaches their area, it is not clear that airborne lead particles from this source pose no hazard to the children of Northport.

Children in Northport may also be at increased risk of lead poisoning from exposure to more local sources. There may be historical soil lead deposits from former activities at the Northport zinc-lead smelter. In 1968, several surface water samples in the Deep Creek drainage system were reported to contain high levels of lead. The source of the lead was not ascertained, and it is not known whether surface waters are currently high in lead.

A teacher in Northport has reported what he considers an excess of children with attention deficit disorder. This condition has been associated with lead poisoning.

Although the exposures outlined above are potential exposures, and although the teacher's report is anecdotal, given the serious nature of lead poisoning, it seems to be prudent public health practice to test for lead.

Mercury

Mercury is a by-product of the smelting process at Cominco. According to authorities in the Trail Lead Program, elemental mercury in residential soils in Trail is at 9 parts per million (ppm). Background levels are believed to be approximately 0.03 ppm. The origin of this mercury and its potential health effect is not known.

DOH recently received a report from the Office of Emergency Management stating that elemental mercury was released into the Columbia River by the Cominco Smelter. Elemental mercury can be converted to methyl mercury by anaerobic bacteria and ingested by bottom feeders (EPA, 1984). However, levels of mercury in fish from Lake Roosevelt seem to be below the Food and Drug Administration action level and median international legal limits (Johnson *et al.*, 1989). It is not known whether mercury is emitted as an airborne particulate from Cominco.

The Superintendent of the Northport Public School District lives in the Sheep Creek area and has reported that he avoids drinking water from his well due to mercury contamination of the water. The source of the mercury contamination is not clear. However, this information, combined with the information about Cominco, indicates that there are potential sources of mercury exposure in the Northport area.

Chronic mercury poisoning results in central nervous system impairment, including visual impairment, tremor, impairment of fine motor function, and personality disorder (Gossel and Bricker, 1984). These symptoms may lead to poor school performance and difficulties similar to those reported by the Northport teacher.

Methods

Target Population

It is proposed that children ages 1 to 3 who live in the Northport School District area be screened for blood lead and mercury. The Superintendent of the Northport School District indicated that this area extends north to the Canadian border, east to Deep Lake, south to the Onion Creek School District, and west to the Sheep Creek areas. Since there have been reports of mercury in the Sheep Creek area, it is recommended that these areas be included even if they are outside the Northport School District boundaries. It is estimated that 60 children meet these criteria.

According to Centers for Disease Control (CDC), children ages 1 to 3 are at highest risk for lead poisoning when the soil is the primary exposure. If these children have elevated blood levels of lead or mercury, screening of children up to age 6 in the Northport School District and children ages 1 to 3 in the Onion Creek School District may be appropriate.

If 60 children are not obtained in the primary age group or if the children ages 1 to 3 do not yield a representative geographic distribution of all children in the area, then it is recommended that the target group be expanded.

Standards

Based on an analysis of cross-sectional and longitudinal studies in several different countries, the CDC concludes that childhood blood lead levels as low as 10 mcg/dL adversely affect nervous system functioning (CDC, 1991). Therefore, the CDC recommends childhood blood lead levels be maintained below 10 mcg/dL. CDC recommends that levels of mercury in whole blood be maintained below 3 mcg/dL (Pascal, 1992).

Blood Collection

According to CDC, venous whole blood is the preferred medium for assessing lead levels (CDC, 1991). Venous blood samples provide a cleaner and more representative specimen than capillary blood samples. Whole blood is also a suitable medium for assessing mercury. One tube of whole blood (approximately 3.5 cc) is sufficient for both lead and mercury analysis.

Due to the skill necessary to obtain venous blood samples from small children, it is recommended that a phlebotomist experienced with children be hired for this project. The phlebotomist will follow blood collection protocols developed by CDC or the laboratory. Samples will be stored and packed according to laboratory protocol. They will be shipped by private carrier for overnight delivery to the laboratory on a work day.

Laboratory Capability

The laboratory recommended to analyze these metals in whole blood is:

ESA Laboratory
43 Wiggins Avenue
Bedford, Massachusetts 01730

This laboratory is a CDC reference laboratory and uses established procedures for analysis of metals in whole blood. The laboratory provides shipping containers, needles, vacutainers, and other supplies necessary for the collection of samples.

Proposal #2: Ascertain Biological Levels Of Copper In Persons With Inflammatory Bowel Disease

Background

Ulcerative colitis (UC) and Crohn's disease (CD) are the most common manifestations of inflammatory bowel disease (IBD). In 1988, Dr. Davis of DOH investigated a reported cluster of UC and CD in the Northport area and concluded that there were approximately 3.7 to 11.1 times the expected number of cases of IBD.

The May 1992 citizens' report listed 18 cases of "colitis, ileitis, etc." An additional 3 cases were reported at the community meeting. Five of these cases duplicated those confirmed by Dr. Davis. The most recently diagnosed case appears to have been within the past year, suggesting the continued presence of a causative agent.

Despite much study, the etiology of IBD remains obscure. Both genetic and environmental factors seem to play a role in disease onset. However, neither biological mechanisms nor specific etiological environmental factors have been identified (Calkins and Mendeloff, 1986; Gilat *et al.*, 1986).

While copper has not been associated with IBD up to now, neither does it seem to have been investigated in relation to this disease. Oral administration of copper above 15 mg causes gastrointestinal symptoms including nausea, vomiting, diarrhea, and intestinal cramp (Sarkar, 1988). Copper sulfate in amounts large enough to cause acute reactions has been associated with erosions and areas of hemorrhage in the gastric and small intestinal mucosae (Chuttani *et al.*, 1965). Data on chronic toxicity is limited. However, one source reports symptoms of chronic copper toxicity to include sporadic fever, vomiting, epigastric pain, diarrhea, and jaundice (Gossel and Bricker, 1984).

Three citizens have reported elevated levels of copper in biological samples. It should be noted that medical records of these individuals have not been obtained to: 1) rule out the presence of genetically inherited, inborn errors of copper metabolism and 2) verify the presence of elevated levels of copper. DNR lists copper as a mining commodity from two mines northeast of Northport and east of the Columbia River, indicating the presence of copper in the area.

Methods

DOH has requested release of information forms from those who were identified with IBD in order to obtain and review the medical records. It is recommended that those with the most recent diagnoses be tested for copper. The copper may create a lesion which leads to disease, but, once established, the condition may persist in the absence of an on-going exposure.

If those with the most recent diagnoses manifest high levels of blood copper, it is recommended that those with less recent diagnoses and a control group matched by age, sex, and geographical location also be tested. The control group is necessary because levels of blood copper vary by geographical location (Stokinger, 1981).

DOH will assess the methods for analyzing copper in blood and urine if a review of medical records indicates that this screening has merit.

PROPOSAL #3: ASCERTAIN LEVELS OF COBALT IN PERSONS WITH SELECTED THYROID DISORDERS

Background

Approximately 20 cases of thyroid disease were reported either at the public meeting or in the citizen reports. DOH is in the process of obtaining medical records for these cases to confirm diagnosis and establish rates in order to determine the extent of disease. DOH will also evaluate the types of thyroid disease and age and dates of onset to ascertain possible etiology. The types of thyroid disease, age, and dates of onset of are important for two reasons.

1) Historically, Northport is a iodine deficient area (Gray 1992). If most of the cases involve goiter and underactive thyroid and occur in those born before the advent of iodized salt, primary iodine deficiency would be the most likely explanation for disease.

2) Also historically, heavy water was produced in the area (Ames 1992). This process may release radioactive iodine. If all of the cases were diagnosed in the time period corresponding to the manufacture of the heavy water, and if the manufacturing of heavy water did, in fact, involve release of radioactive iodine, this source of exposure will need to be further investigated.

In addition to these exposures, naturally occurring substances in foods, and bacterial and chemical contaminants in water have been associated with thyroid disease. DOH has reviewed the literature on goitrogens and concluded that exposure to cobalt is the most likely goitrogen to which the population may be exposed. Cobalt interferes with iodine uptake by the thyroid (Kriss *et al.*, 1957), and epidemiologic studies suggest increased incidence ofgoiter in regions with relatively high levels of cobalt in water and soil (Goyer, 1991). Cobalt is usually found with copper (Goyer, 1991) and, as indicated in Proposal #2, the Northport area is rich in copper. Additionally, DNR lists cobalt as a commodity from the Deep Lake area.

Methods

If primary iodine deficiency and exposure to radioactive iodine can be ruled out as causes of thyroid disease, and if the types of thyroid disease that predominate are not primarily hereditary, it is proposed that individuals with thyroid disorder be tested for cobalt.

The literature reports normal serum values range from 0.02 to 0.06 mcg/L, and whole blood values range from 0.6 to 1.8 mcg/L. About 80 percent of ingested cobalt is excreted in the urine. DOH will investigate measuring cobalt in serum, whole blood, and urine and make a recommendation concerning the preferred medium if the review of medical records indicates the need for testing.

SECTION 3: FOLLOW UP ACTIVITIES IN RELATION TO THE PROPOSAL FOR BLOOD LEAD AND MERCURY SCREENING IN CHILDREN

Background

The Northeast Tri-County Health District and DOH are planning to analyze levels of lead and mercury in the blood of children ages 1 to 3 who live in the Northport and Onion Creek school districts. Blood drawing is planned for December 16-18, 1992. Analytical results should be available by the end of January 1993.

DOH believes that residues from the old lead-zinc smelter and from current and historic lead mining, as well as soils naturally rich in metals, offer potential sources of exposure to lead. The milling tailing pond for one of the currently operating mines is located within a short distance of the Onion Creek School.

Young children are more likely to have elevated blood lead levels than older children and adults because they absorb lead more easily and they have more hand-to-mouth contact. Children are not at a higher risk of mercury poisoning than adults, but they can serve as indicators for poisoning in the larger population. Since no additional blood needs to be drawn to test for mercury, mercury testing of the children seems prudent at this time. If the 1- to 3-year-old children do not have elevated levels of lead or mercury, it is unlikely that older children or adults will have elevated levels of these metals. However, if the 1- to 3-year-olds have elevated levels, funds will be sought to screen children ages 4 to 6 years.

Responsibilities

A meeting between Northeast Tri-County Health District and DOH took place on October 26, 1992, in order to discuss the proposal for blood lead and mercury screening in children. Responsibilities outlined at the discussion were the following:

<u>Northeast Tri-County</u>

- Identify clinic sites within Northport and Onion Creek.
- Notify community regarding clinic purpose, time, and place by means of school district mailing lists, posters, and newspaper articles.
- Develop a mechanism for clinic appointments.
- Contact a professional phlebotomist to do blood drawing.
- Provide staffing of the clinic.
- Develop a consent form for release of information and informed consent to draw blood.

- Inquire as to personalizing the DOH lead brochure and the feasibility of local printing.

DOH

- Coordinate with ESA laboratories for supplies and shipping of blood samples (shipping to and from the local health district).

- Write technical information to be included in the newspaper article to be developed by the local health district.

- Develop and write a report for the December 2, 1992, State Board of Health meeting.

- Produce Mercury fact sheet.

DOH staff visited the Trail Lead Program Office, Trail, British Columbia, on October 27, 1992. This meeting was held by invitation of Terry Oke, Project Director, and Dr. Nelson Ames, Director/Medical Health Officer, Central Kootenay Health Unit, Castlegar, British Columbia.

The clinic staff shared information regarding clinic procedure, environmental sampling, and public health education. They were very helpful and provided educational materials and samples of notification letters and documents. The health coordinator and medical director emphasized that a technical staff which specializes in drawing blood on children was a real asset.

DOH staff shared the methodology and experience of the Trail Lead Program Office with the Northeast Tri-County Health District after the October 26, 1992, meeting.

REFERENCES

Ames, Neslon, M.D., personnel communication.

Calkins, B.M. and Mendeloff, A.I. "Epidemiology of Inflammatory Bowel Disease." *American Journal of Epidemiology, 8*:60-91, 1986.

CDC. *Preventing Lead Poisoning in Young Children.* U.S. Department of Health and Human Services, 1991.

Chuttani H.K., Gupta P.S., Gulati S., and Gupta D.N. "Acute copper sulfate poisoning." *American Journal of Medicine, 39*:849-854, 1965.

EPA. *Mercury Health Effects Update: Health Issue Assessment.* EPA-600/8-84-019F, August 1984.

Gilat, T., Langman, M.J.S., and Rozen, P. "Environmental factors in inflammatory bowel disease." *Front. Gastrointestinal Research, 11*:158-176, 1986.

Gossel T.A. and Bricker J.D. *Principles of Clinical Toxicology.* New York, Raven Press, Inc., 1984.

Goyer R.A. "Toxic Effects of Metals." In *Casarett and Doull's Toxicology: The Basic Science of Poisons, Fourth Edition,* eds. Amdur M.O., Doull J. and Klaassen C.D., pp 623-680. New York, Pergamon Press, Inc., 1991.

Gray E.W., M.D., personnel communication.

Johnson A., Norton D., and Yake B. *An Assessment of Metals Contamination in Lake Roosevelt.* Olympia, WA, Washington State Department of Ecology, 1989.

Kriss J.P., Carnes W.H., and Gross R.T. "Hypothyroidism and thyroid hyperplasia in patients treated with cobalt." *Journal of the American Medical Association, 157(2)*: 117-121, 1955.

Pascal D. personnel communication.

Sarkar B. Copper. In *Handbook on Toxicity of Inorganic Compounds*, eds. Seiler H.G. and Sigel H., pp 265-276. New York, Marcel Dekker, Inc., 1988.

Stokinger H.E. "The Metals." In *Patty's Industrial Hygiene and Toxicology, Third Revised Edition*, eds. Clayton G.D. and Clayton F.E., pp 1620-1630. New York, John Wiley and Sons, 1981.

APPENDIX A

KRISTINE GEBBIE
Secretary

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
OFFICE OF TOXIC SUBSTANCES
Airdustrial Center, Building 4 • P.O. Box 47825 • Olympia, Washington 98504-7825

September 14, 1992

The Washington State Department of Health (DOH), in collaboration with the Northeast Tri-County Health District, is investigating thyroid disease and colitis in the Northport and Kettle Falls areas. Public meetings and reports to DOH have alerted us to the possibility that there are more people with these diseases in Northport and Kettle Falls than expected.

The first step in this investigation is to gather some basic information and to review the medical records of those who have reported these conditions either to us directly or to community members who have given us your name. The questionnaire will be used to find out where those with disease live and what water they use. The medical records will be used to look at specific diagnoses, since both of these conditions have more than one form; date of diagnosis; and the course of disease.

We are asking you to complete the enclosed questionnaire and release of information forms. The release forms will allow your medical care provider to send us copies of your medical records. If you have been seen by more than one doctor or at more than one medical care facility for your condition, please complete a form for each doctor or medical care facility. If you need more than the four forms provided, you may either make photocopies or request more forms from us. Please return the questionnaire and release forms in the envelope provided.

All information will remain confidential. Records will be reviewed only by DOH personnel and will be kept in a locked file cabinet when not being used. Reports will contain information from all of the records and you will not be identified.

While your participation in this project is voluntary, it is important that we have as complete information as possible. If we find more disease than expected, we hope to begin a follow-up program to look at possible causes of disease.

If you have questions about this project, you can call the Health Consumer Assistance Line at 1-800-525-0127. Leave a message asking to speak to Kim Field at 586-6179 or Juliet VanEenwyk at 753-3336. You will also need to leave your name and phone number and to identify yourself as calling about the Northport project. You can also call us directly at 206-586-6179 (Kim Field) or 206-753-3336 (Juliet VanEenwyk). If you call us directly, we will take your number and call you back.

Thank you for you cooperation with this effort. We hope the information will help clarify some of the health concerns voiced by citizens in the area.

Sincerely,

Kim Field, R.N.
Environmental Health Assessment Section

Sincerely,

Juliet VanEenwyk, Ph.D.
Environmental Health Assessment Section

Enclosures

mj C:\wp51\kim\cover1

QUESTIONNAIRE

Name ______________________

Date of Birth ________________

1. Where do you currently live? (Complete "a" **OR** "b".)

a. In Town

____
number and street

____
nearest cross street

____
town

b. Outside of Town

Give the nearest town and your street address

____
nearest town

____
street address

AND give directions for locating the residence on a map, e.g., 5 miles south of Northport on Highway 20.

2. How long have you lived at this location? ________

3. What is your main source of drinking water? (Complete one item from "3a" **AND** one item from "3b".)

3a. [ ] public or community system, name ________________
[ ] single family system
[ ] bottled water
[ ] other, please specify ______________

3b. [ ] well
[ ] underground spring
[ ] creek, river, lake
[ ] unknown
[ ] other, please specify ______________

7. Where did you live before the residence described in question #4. (Complete "a" **OR** "b".)

a. In Town

____
number and street

____
nearest cross street

____
town

b. Outside of Town

Give the nearest town and your street address

____
nearest town

____
street address

AND give directions for locating the residence on a map, e.g., 5 miles south of Northport on Highway 20.

8. How long did you live here? __________

9. What was your main source of drinking water? (Complete one item from "9a" **AND** one item from "9b".)

9a. [ ] public or community system, name ___________________
[ ] single family system
[ ] bottled water
[ ] other, please specify __________________

9b. [ ] well
[ ] underground spring
[ ] creek, river, lake
[ ] unknown
[ ] other, please specify __________________

4. Where were you living when you were first diagnosed with colitis, thyroid or related disease? (Complete "a" **OR** "b". If this residence is the same as in item #1, you can write "same" and go to question #5.)

a. In Town

____
number and street

____
nearest cross street

____
town

b. Outside of Town

Give the nearest town and your street address

____
nearest town

____
street address

AND give directions for locating the residence on a map, e.g., 5 miles south of Northport on Highway 20.

5. How long did you live here before developing symptoms of colitis, thyroid or related conditions? __________

6. What was your main source of drinking water at this location?
(Complete one item from "6a" **AND** one item from "6b". If the same as in question # 3, write "same" and go to question #7.)

6a. [ ] public or community system, name __________________
[ ] single family system
[ ] bottled water
[ ] other, please specify ________________

6b. [ ] well
[ ] underground spring
[ ] creek, river, lake
[ ] unknown
[ ] other, please specify ________________

10. Where did you live for the longest amount of time before you were 18 years old? (Complete "a" **OR** "b" or if the same as in question 1, 4, or 7 write "same as in question ..")

a. In Town

____
number and street

____
nearest cross street

____
town

b. Outside of Town

Give the nearest town and your **street** address

____
nearest town

____
street address

AND give directions for locating the residence on a map, e.g., 5 miles south of Northport on Highway 20.

11. How old were you when you lived at this location?

beginning age _________ (enter 0 if before 1 year old)

ending age _________

12. What was your main source of drinking water at this location? (Complete one item from "a" **AND** one item from "b".)

12a. [ ] public or community system, name ____________________
[ ] single family system
[ ] bottled water
[ ] other, please specify __________________

12b. [ ] well
[ ] underground spring
[ ] creek, river, lake
[ ] unknown
[ ] other, please specify __________________

13. What is you current occupation? ___________________________

14. How long have you been engaged in this type of work? __________

15. Did you ever swim regularly (at least once a month in the summer) in any lakes or rivers in the area?

[ ] Yes
[ ] No

If YES, in which bodies of water did you swim and how often did you swim?

____
name frequency

____
name frequency