YUKON
STATE OF THE ENVIRONMENT
INTERIM REPORT 1997

A Focus on Air Quality & Climate Change

Yukon
Renewable Resources

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For additional copies of this report please contact:

Yukon Department of Renewable Resources
Policy and Planning Branch
Box 2703
Whitehorse, YT Y1A 2C6
Phone (867) 667-5634
Fax (867) 393-6213

ACKNOWLEDGEMENTS

Prepared by:
Jane Marshall for Yukon Department of Renewable Resources

Co-ordinator:
Jerome McIntyre (Yukon Department of Renewable Resources)

Reviewers and Contributors

Yukon Government:
Ben Moise, Jim Connell, Karyn Armour, Bengt Pettersson, Janine McJannet, Scott Heron, Joe Ballantyne (Renewable Resources), Toby Sanger (Executive Council Office), Suzzanne Green, Paul Kishchuk, Derrick Hynes, Bob Collins (Economic Development), Robin Hamilton (Women's Directorate).

Federal Government:
Joan Eamer, Vic Enns, Stan Liu (Environment Canada)

Yukon Council on the Economy and Environment:
Jennifer Mauro (Chair), Andy Williams (Yukon Conservation Society), Louise Bouvier (Yukon Indian Women's Association), Daryn Leas (Council of Yukon First Nations), Kathy Watson (Association of Yukon Communities), John Carroll (Yukon Chamber of Commerce), Dave Austin (Yukon Chamber of Mines), Louise Ranger (Yukon Federation of Labour), Lucy Van Oldenbarneveld (Yukon Status of Women Council), Ralph Nordling, George Johnson (Council of Yukon First Nations).

Others:
Sabine Schweiger, Jackie Hynes, Charlie Stolte (City of Whitehorse), John Maissan (Yukon Energy Corporation), Dr. Christopher R. Burn (Carleton University).

ABOUT THIS REPORT

The Yukon *Environment Act* requires a state of the environment report to be completed once every three years along with interim reports in intervening years. The focus of this interim State of the Environment Report is on air quality and climate change.

The purpose of State of Environment (SOE) Reporting, as outlined in the *Environment Act*[1], is to provide early warning and analysis of potential problems for the environment; to allow the public to monitor progress toward the achievement of the objectives of the *Environment Act*; and to provide baseline information for environmental planning, assessment and regulation.

The SOE Report is designed to answer four basic questions:

- What is happening in the environment?
- Why is it happening?
- Why is it significant?
- What are we doing about it?

Where possible, the State of the Environment Report should use indicators to answer these questions. Indicators should also demonstrate whether the changes that are occurring to the environment are positive or negative. The State of the Environment Report does not make recommendations, set policy or present a report card on the environment. It does, however, provide us with important information to help us make the right decisions to build a sustainable economy and conserve a healthy environment.

Information from this report comes from government and research reports and files, and from discussions with representatives from Environment Canada (Environmental Protection and Canadian Wildlife Service), Yukon government (Community and Transportation Services, Renewable Resources), City of Whitehorse, Yukon Energy Corporation, and researchers and scientists across Canada. In addition, statistical information was obtained from the Yukon Bureau of Statistics. Although data for many of the graphs contained within this report are not available on an annual basis, every effort has been made to provide the most up to date information possible. Where appropriate, this new information is compared to that presented in the 1995 SOE Report.

HIGHLIGHTS OF THE 1997 STATE OF THE ENVIRONMENT INTERIM REPORT

The *Yukon State of the Environment Interim Report* for 1997 provides an examination of the changes that have occurred to air quality and climate change since the first Yukon State of the Environment Report was completed in 1995. Specific topics discussed in the report include global warming, depletion of the ozone layer, long range atmospheric transport of contaminants, and local issues such as woodsmoke and open burning of solid waste. The report uses indicators to answer the questions: What is happening? Why is it happening? Why is it significant? and What are we doing about it?

Since the first State of the Environment Report was completed in 1995, the following changes are noted:

Climate Change

- Yukon emissions of carbon dioxide from the burning of fossil fuels rose from 475 kilotonnes in 1993 to 570 kilotonnes in 1995. In 1995, the Yukon contributed less than 1% to Canada's overall carbon dioxide emissions. The Yukon's per capita emissions during this time period were 10.26% below the national average.

- Transportation remains the largest source of Yukon greenhouse gas emissions. Statistics on the number of registered vehicles, per capita consumption of gasoline and aircraft movement, show that transportation activity in the Yukon is on the rise.

- Further studies of mean summer temperatures at three sites in the Northern Yukon support the first Yukon State of the Environment Report's findings that there has been a statistically significant increase in Yukon summer temperatures since the beginning of the century.

- Predicted changes under a global warming scenario suggest that effects of climate change will be complex and will be felt throughout various pathways such as the physical environment, natural and managed ecosystems, economic sectors and aboriginal lifestyles.

- Initiatives currently underway to reduce greenhouse gas emissions include Yukon energy saving programs, experimentation with wind generated electricity, and efforts to increase the use of public transit and active transportation methods (i.e. walking, biking). Whitehorse City Council has also adopted the Canadian Declaration on Climate Change.

Ozone Depletion

- Long term monitoring shows that levels of ozone in the stratosphere are steadily declining and are consistently below pre-1980 levels within Canada and across the globe. In 1997 the ozone layer over the Canadian Arctic was as much as 45 per cent below normal.

- At the international level, world representatives recently marked the 10th anniversary of the Montreal Protocol and estimated that if the Protocol is followed, the net economic benefits of protecting the ozone layer from 1987 to the year 2060 will produce $224 billion in net economic benefits. It will also save a third of a million lives by reducing the incidence of sun-induced skin cancer.
- To control the release of ozone depleting substances, chemicals which thin the ozone layer, the Yukon government enacted 'Ozone Depleting Substance Regulations' which came into effect in February 1996.
- In 1997, the weather station at Sheep Creek in Ivvavik National Park began monitoring UV-B levels through the Parks Canada monitoring program.

Long Range Atmospheric Transport of Contaminants

- Concentrations of human-made organochlorines in air, water, animals, plants and people in the North remains a problem. Recent studies indicate that highest concentrations of organochlorines can be found in marine mammals.
- It is the opinion of Arctic Environmental Strategy researchers that the benefits of traditional/country foods outweigh the possible risks of long-term, subtle effects associated with current levels of contaminants in these foods.
- In an effort to take action on the problem of organochlorines in the North, further research is being carried out by eight Arctic countries including Canada. Canada is also working with countries in the southern hemisphere to find ways to stop their use of contaminants.

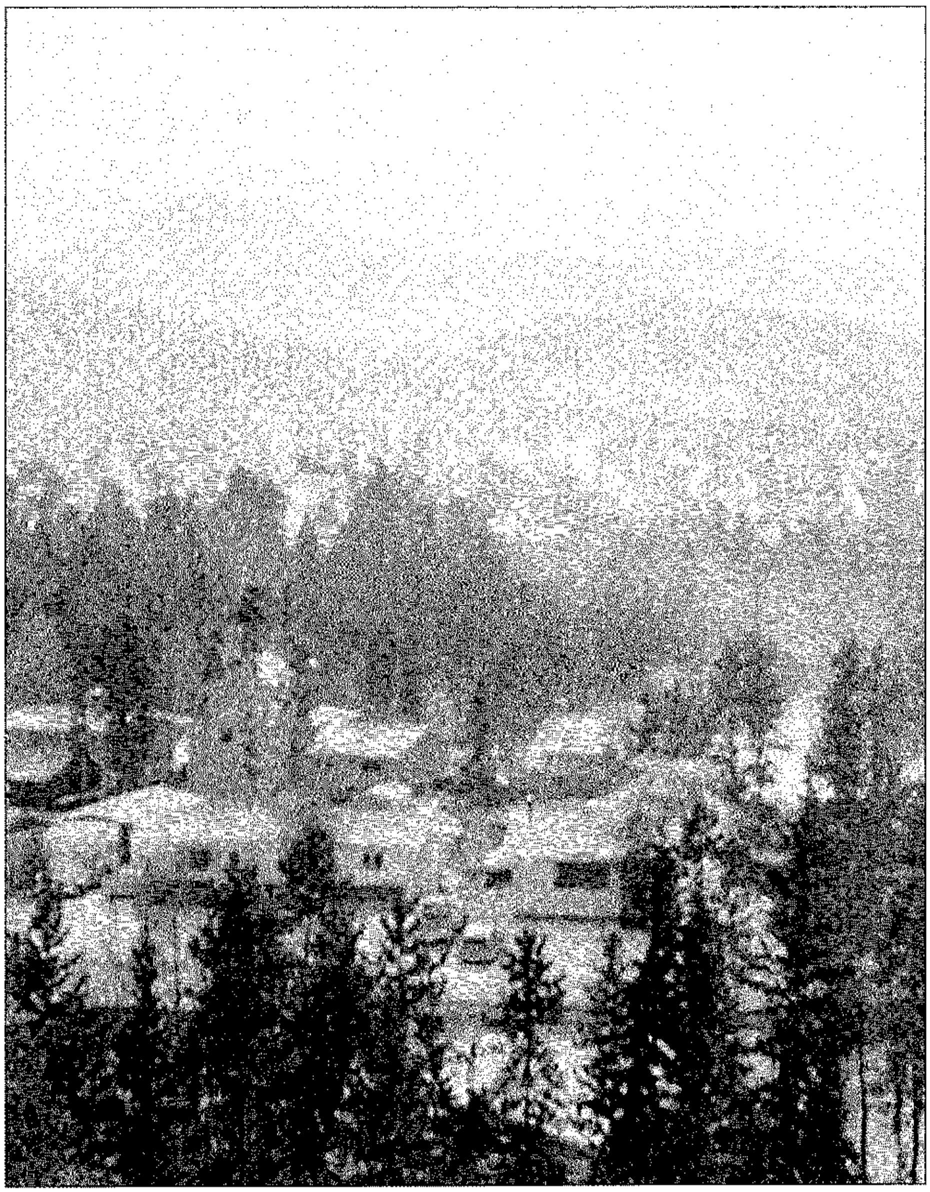
Local Air Quality Issues

- The Yukon remains one of the few areas in Canada where the burning of garbage is unregulated. Prior to 1997, all Yukon communities with the exception of Whitehorse burned their waste. The Yukon Government has recently decided to prohibit the practice of burning garbage at the Mt. Lorne site. Haines Junction and Dawson also have plans to phase out the burning of garbage. The Yukon government is working on Air Emission Regulations to address problems associated with waste burning and air contaminants released from motor vehicle exhaust and large industrial boilers, burners, and engines. Solid Waste Regulations are also expected to be finalized by the end of 1998 which may include requirements for burning garbage.
- During 1992-1994 the operation of the downtown Whitehorse air quality monitoring station was transferred from the federal government to the Yukon government. Data obtained since then suggests that the amount of lead particles in the air has dropped to the lowest level since 1978.
- In 1996 there were no 'high events' of carbon monoxide or nitrogen dioxide which exceeded the National Ambient Air Quality Objectives.

- Analyses of the 1985-1996 period shows that levels of carbon monoxide and nitrogen dioxide vary seasonally with the highest levels occurring during the winter months.

- Between 1992 and 1996 the annual number of 'no burn' periods, intended to reduce woodsmoke problems in Riverdale, ranged from one to three. Recent scientific studies link woodsmoke and fine particles to human health effects. Within the City of Whitehorse the number of new pellet and wood stoves installed has been declining in recent years.

- Recent (1997) amendments to the City of Whitehorse 'Wood Smoke Bylaw' require that all wood stoves installed after March 1, 1997 must meet air emission standards. In addition, the limit at which a 'no burn' period is called was lowered from 120 to 110 micrograms per cubic metre.



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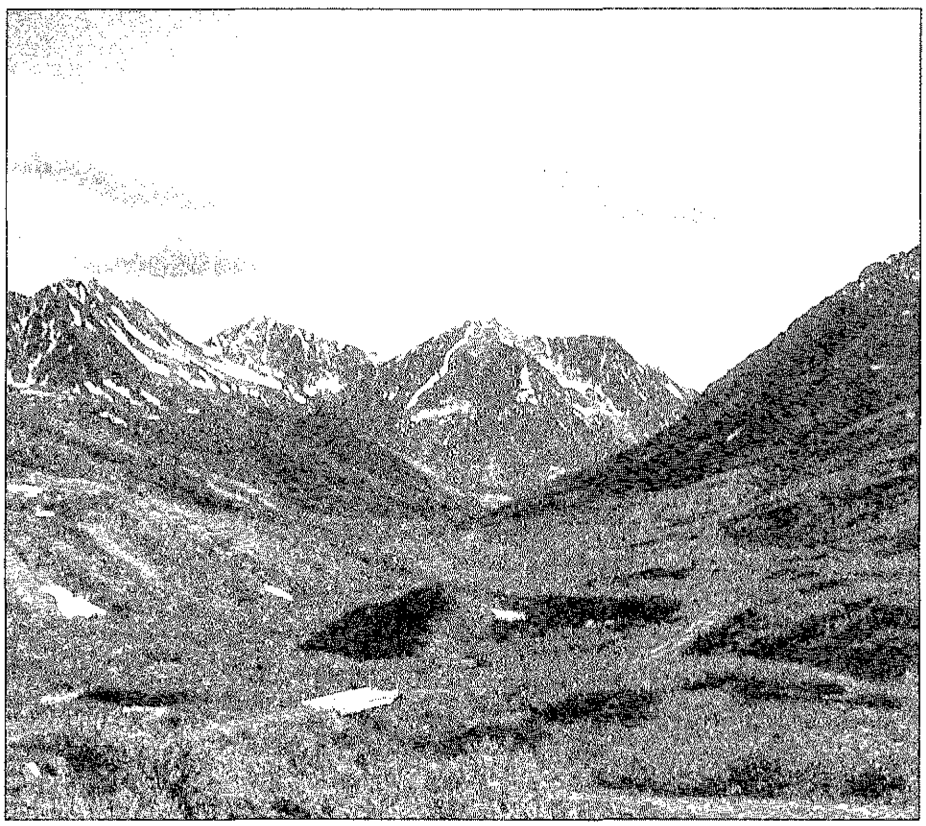
5.0 LOCAL AIR POLLUTION ISSUES

INSETS

1.0 INTRODUCTION

The earth's atmosphere performs a variety of important functions that are necessary to maintain life on earth. The atmosphere supports all biological activities, it keeps temperatures at the earth's surface relatively constant, and it shields living things from harmful ultraviolet radiation. The earth's atmosphere is also very fragile and susceptible to change. Evidence suggests that some human activities are having an impact on the atmosphere's ability to perform these vital processes.

For the Yukon, the most significant air-related issues are global warming, depletion of the ozone layer, long range atmospheric transport of contaminants, and local issues such as woodsmoke and the open burning of waste. These air-related problems are a result of various stresses from human activities occurring in and outside the Yukon. Activities such as transportation, home heating, electricity generation, waste management practices and the use of harmful chemicals in every day life are discussed in this report. Stresses from these activities can be measured by indicators such as the number of vehicles registered in the Yukon, the number of woodstoves that were installed, or emissions of greenhouse gases. Impacts of these activities are described in various ways such as temperature trends in the Yukon, ozone layer thickness from year to year, measurements taken from air quality stations and contaminants in the food chain. Socio-economic effects are discussed in terms of human health and aboriginal lifestyles. Human response to these conditions answers the question, What are we doing about it? Some responses discussed in this report include methods to influence lifestyle choices (behavioural change), legislative and regulatory control, setting objectives and monitoring, technological advancements and public education.



2.0 CLIMATE CHANGE

2.1 What is the Enhanced Greenhouse Effect?

The Earth's climate is ideally suited for life. A primary reason for this life-support climate system is the presence within the atmosphere of some important gases often referred to as 'greenhouse gases'. These gases behave as an insulating blanket by absorbing and returning outgoing radiation, thereby trapping heat in the lower atmosphere. This naturally occurring phenomenon, often called the 'greenhouse effect', is essential for a livable climate on earth. However, the delicate balance of these gases within the atmosphere has been altered by human activities. Elevated concentrations of greenhouse gases, such as carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons have the effect of raising temperatures or causing an *enhanced* greenhouse effect. The increase in concentrations of these gases is due to the rise in global population, increased consumption of coal, oil and gas, deforestation, agriculture, land use changes and industrial processes.[2]

Figure 2.1

Yukon Emissions of Carbon Dioxide from the burning of Fossil Fuels, 1993

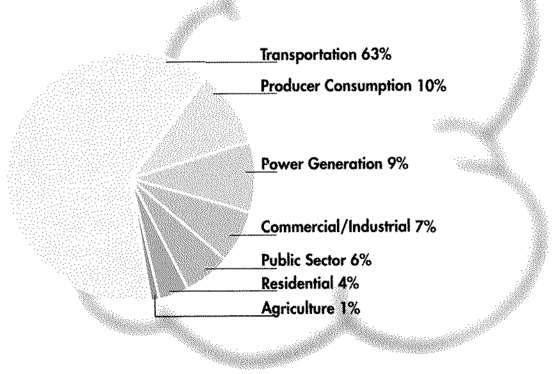
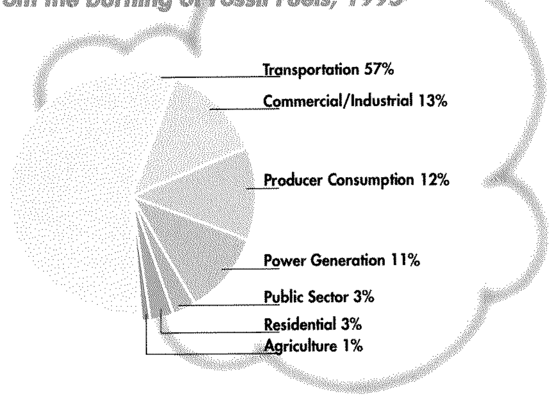


Figure 2.2

Yukon Emissions of Carbon Dioxide from the burning of Fossil Fuels, 1995



Total emissions were estimated at 570 kilotonnes for 1995. This includes carbon dioxide emissions from wood heating but does not include emissions from natural sources. Emission estimates are from records of fuel use.

2.2 Yukon Greenhouse Gas Emissions

Yukon emissions of carbon dioxide from the burning of fossil fuels rose from approximately 475 kilotonnes in 1993 to 570 in 1995. This accounted for less than 1% of Canada's overall carbon dioxide emissions.[i] In 1995, the Yukon's per capita emissions were 10.26% below the national average. Figures 2.1 and 2.2 show the percentage contribution from different sectors to total greenhouse gas emissions in 1993 and 1995. During this period, the most notable increases in emissions occurred in the industrial and commercial sector which are likely due to the reopening of the Faro mine.

Most of the Yukon's electricity is generated by hydro-power (81% in 1995). The remaining electricity is produced by diesel generators (18%) and a wind powered turbine in Whitehorse (less than 1%). Diesel fuel used to generate electricity accounted for 11% of the Yukon greenhouse gas emissions in 1995. Emissions from this sector rose from 42 kilotonnes of CO_2 equivalent in 1993 to 63 kilotonnes in 1995.

Generally, increases in the use of electricity can be explained to some extent by changes in mining activity. The lead zinc mine in Faro is by far the largest single consumer of electricity in the Yukon. When in operation, the Faro mine typically uses 40% of all electricity produced on the Whitehorse-Aishihik-Faro system.

Electricity demand is always highest in the winter as a result of greater heating and lighting needs. Hydro supply is generally

[i] Emissions were expressed as 'kilotonnes of carbon dioxide equivalent'. Actual greenhouse gases measured were CO_2, CH_4, N_2O, CF_4, C_2F_6 and SF_6

lowest in the winter because of the lower flow rates. Therefore, more diesel is generally used to meet the added demand. During the winter months when the Faro mine is in operation, diesel accounts for approximately 22 % to 23 % of all electricity produced. In 1995, diesel accounted for 18% of the total electricity produced in the Yukon. In 1996 this percentage share increased to 28%[3]. The 10% increase in use of diesel was a result of the Faro mine coming on line, lower than average flow rates on the Yukon River, and "draw-down" restrictions imposed at Aishihik Lake.

A 1991 statistic suggested that the Yukon's per capita energy consumption is higher than the national average and the third highest in Canada.[4] Several factors contribute to this high per capita consumption. For instance, cold climate conditions create large demands for space heating and other energy consuming devices. The long distances between Yukon communities and a low density pattern of development has also made the Yukon very dependent on transportation and the use of refined petroleum products.

The transportation sector remains the number one contributor to greenhouse gas emissions in the Yukon. Total emissions from this sector *increased* from 294 kilotonnes in 1993 to 318 kilotonnes in 1995. For this reason, transportation in the Yukon deserves further discussion.

2.3 A Focus on Yukon Transportation

2.3.1 Greenhouse Gas Emissions Within the Yukon Transportation Sector

In 1995, gas and diesel road vehicles accounted for the majority of the greenhouse gas emissions in the transportation sector, generating 135 and 123 kilotonnes respectively. The increase in the emissions from transportation is reflected by the increase in the number of vehicle registrations in the Yukon (Figure 2.3). In 1995 there were 20,250 passenger automobiles and 11,074 trucks and truck tractors in the Yukon. In 1996, the per capita consumption of gasoline in the Yukon was 38.3% higher than the national average of 3.24 litres per day.[5]

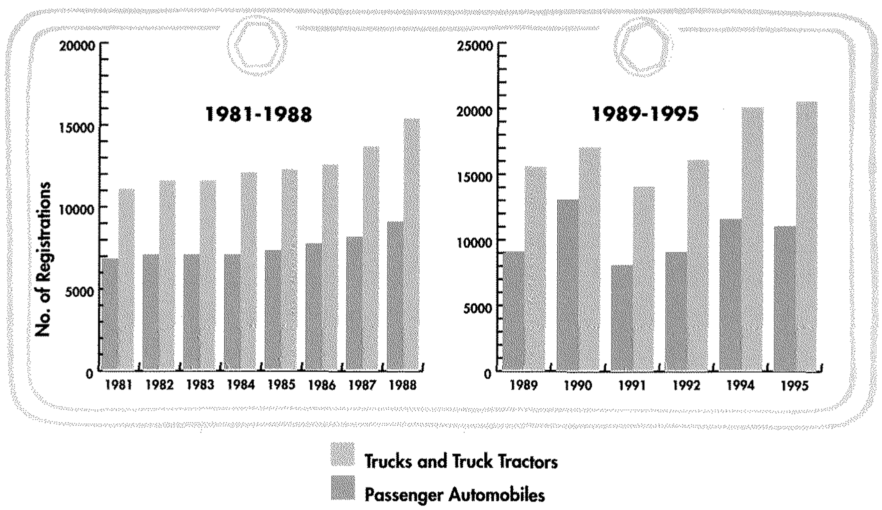


Figure 2.3

Vehicle Registrations in the Yukon

Note: *A new staggered system for registration renewals was implemented in the first months of the 1989-90 start up period. Individuals were allowed to renew for as long as 23 months. Therefore, yearly registration counts after 1989 do not always represent the total number of registered vehicles in the Yukon.*

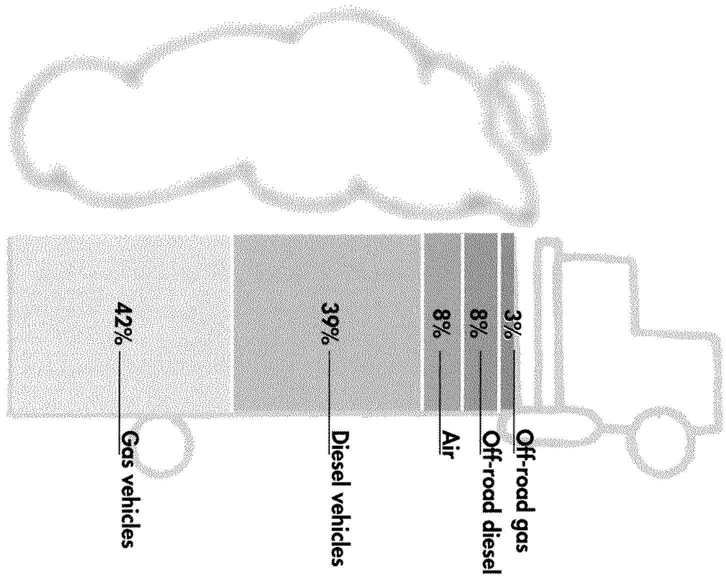
The high consumption of gasoline can be explained to some extent by the amount of tourist travel. The Yukon supports a healthy tourism industry which drew 206,800 visitors during the summer months of 1997 up from 193,700 visitors in 1987[6]. Although it is difficult to say what proportion of Yukon air emissions are due to tourist travel, trends in the modes of transport that tourists use can be examined. For instance, a comparison of the 1987 and 1994 Yukon Exit Survey results showed that tourist travel by bus/coach was on the decline while car/truck/van and motorhomes/RV/camperized bus were on the increase.[7]

Figure 2.4

Percentage share of greenhouse gas emissions by vehicle type 1995

(kilotonnes of carbon dioxide equivalent)

While air travel accounted for a small percentage of the total transportation emissions, these emissions seem to be steadily increasing.



Yukon Department of Tourism air travel statistics also confirm that there has been an increase in air travel emissions. Between 1995 and 1996 there was a 53.7% increase in the number of non-residents traveling by air via the Whitehorse International Airport during the peak tourism period of June to September. The increase in air travel may be due in part to the new air carrier service to Vancouver offered by NWT Air and Royal Airlines in 1996. The Canadian Tourism Commission forecasts air travel to Canada will grow at a fast pace due to a relatively low Canadian dollar, and the deregulation associated with the *Open Skies Agreement*.[8] These trends in the way tourists travel are significant because automobiles and planes use more fuel and emit more carbon dioxide per passenger for a given distance of travel than do trains and buses.[9]

2.4 Temperature Trends: Are We Getting Warmer?

In 1988, the World Meteorological Organization and the United Nations Environment Programme established a special team of the world's leading scientists to determine whether or not the world's climate was changing. In 1995, the Intergovernmental Panel on Climate Change, concluded that there is a "discernible human influence on global climate and that this influence represents an important additional stress on the global ecosystem."[10] Changes to average world wide temperatures appear to support this argument. For instance, the 1980s and 1990s have had the majority of the warmest years since worldwide record keeping began nearly 140 years ago. Global temperatures rose in 1995, making it the hottest year ever recorded. Recent data suggest the national average temperature for summer 1997 (June through August) was 0.6°C above the long term average.[11] Widely accepted estimates project that the Earth's average temperature might increase by about 2°C during the next 100 years. This would be an unprecedented rise and the average rate of warming would be greater than any seen in the last 10 000 years.[12]

Global warming predictions state that temperature changes will be the greatest in the polar regions. The 1995 State of the Environment (SOE) Report noted that summer temperatures in the Yukon and Northern B.C. showed a slight, but statistically significant, increase since the beginning of the century. The growing season at Mayo was shown to have become warmer, whereas winter temperatures showed no clear trend.

Recent studies confirm the trends identified in the 1995 SOE Report. For instance, analyses of temperature records for the northern Yukon have shown significant increases in mean summer temperatures at three sites: Komakuk Beach, Old Crow and Shingle Point (Figure 2.5). At these locations, average summer temperatures have increased more than 1°C from the 1960s to present.[13]

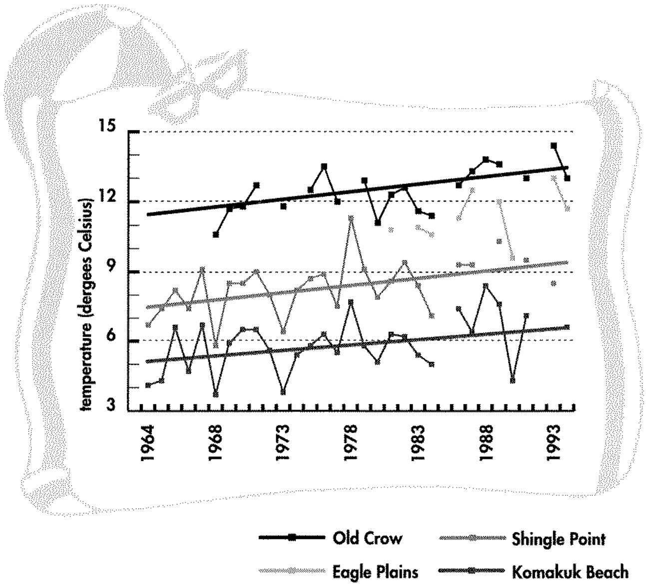


Figure 2.5

Mean Summer Temperatures (June-August): Northern Yukon

2.5 Tracking Climate Change With Indicators

To determine the extent of global warming, it is necessary to track climate patterns over the long-term. However, one of the difficulties with following long term climate changes is the absence of extensive instrument records. For this reason, scientists often use indicators such as ice-cores, pollen records, or tree-rings to infer past climate patterns. For instance, two researchers with Queen's University[ii] and the University of California, Los Angeles[iii] recently sampled spruce rings at five sites in the Mackenzie and Franklin Mountains, N.W.T., and the Ogilvie and Richardson Mountains in the Yukon. Using this indirect measure, they concluded that there has been a warming trend over the past 150 years. This technique, known as 'dendrochronology', recognizes that trees leave a record of their growth in annual rings. In good growth years (e.g. warm summers) the ring is relatively wide, while in poor weather years the ring is narrower. The end result is a series of tree rings reflecting what may have occurred many hundred years before present.[14]

[ii] Sceicz, J.
[iii] MacDonald, G.

Another indicator used to track climate patterns is changes in permafrost temperature. Permafrost is ground that remains frozen for two or more years. If a climate change occurs, temperatures rise within the upper layer of permafrost. A researcher with Carleton University in Ottawa has conducted recent studies in the Yukon on permafrost, however linking changes in permafrost to climate warming is not a simple process. At a study site in Mayo, evidence of permafrost warming was found for the period of 1970-1992, with greatest warming occurring in the last few years of the 1980s. Near surface ground temperatures increased by about 1.5°C to around -1°C by 1992. Since then, winters have gotten colder, there has been less snowfall and the ground has cooled off.

A more recent study was undertaken near the Takhini River Bridge on the Alaska Highway, 50 km west of Whitehorse. Temperatures in permafrost depths of up to 5m below the ground surface were monitored and showed no warming or cooling trends over the period 1982-1996.[15]

While the above discussion demonstrates the importance of science to the study of climate change, the contribution of traditional knowledge should also be emphasized. A researcher studying oral and scientific traditions in the Yukon Territory concluded that these two traditions, when combined, provide a broader perspective on the natural environment. Oral tradition is testimony transmitted verbally from one generation to the next or more. In terms of studying global climate change, this information is of value since Yukon First Nation people have developed an intimate knowledge of the land from which they have derived their livelihood.[16]

At a recent symposium on "Impacts of Climate Change on Resource Management in the North", Norma Kassi of the Vuntut Gwitchin offered a First Nation's perspective on climate change. She emphasized the importance of a healthy environment to their livelihood and stated that her people are directly affected by climate change.

> *There is only one way for our people. This is the way of our ancestors and the ways of the people that came before them. If we do not learn and practice their methods, our 'environment' will disappear. And because we are a subsistence people, if our 'environment' disappears, the Vuntut Gwitchin will also disappear.*[17]

In addition, she noted the effects of climate change...

> *...the people of my village started talking about the changes they were noticing. The summers were getting hotter. The winters were getting warmer. People would go out onto the Flats [Old Crow Flats] and get sun-burned. The wetlands are starting to dry up ...The permafrost is thawing...Our lakes are disappearing. Lakes that I grew up beside, some of the lakes that I fished in and trapped on as a young girl have now disappeared. They are now just big patches of mud and willows. There is hardly any snow in winter now and what little there is melts too soon in the spring. As a result we have been experiencing floods. Last spring the whole village was flooded and we had to evacuate our people.*[18]

At the "Elders on the Environment" session held in May, 1994 Effie Linklater from Old Crow also spoke of the climate change she observed.

> *I think the last real cold weather we had in the north was 1964 the time I came down here. And it was cold...And since 1964 I notice the climate really change. Like even around Old Crow it's like that, that's cold country. And sometime they still have rain in the middle of the winter, it never used to be like that.*[19]

2.6 Predicting Impacts of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) has concluded that increased concentrations of carbon dioxide and other trace gases will lead to a warming of the world's climate. It is also generally agreed that this warming is occurring faster at higher latitudes. For this reason, it is extremely important to monitor and study the North as an early indicator of climate change. Recently, two important studies in the Canadian North have been examining these important questions. What if the world becomes warmer? What would the effects of warming be? Would it make a difference to our future, and those of our children?[20]

The '*Mackenzie Basin Impact Study*' was one of the first attempts to investigate the integrated impacts of global atmospheric change at the regional level. This six-year research project was initiated by Environment Canada in 1990. The region chosen included the land area drained by the Mackenzie River and its tributaries (1.8 million km^2) which includes parts of British Columbia, Alberta, Saskatchewan, Northwest Territories and the Yukon[21]. The second study is the '*Canada Country Study: Climate Impacts and Adaptation*', the first phase of which began in the summer of 1996 and concluded in the fall of 1997. This phase addressed the need to better understand and document regional climate change detection.[22]

Some of the changes that were predicted in the Canada Country Study are of particular relevance to the Yukon[23] These are as follows:

Predicted Changes in the Yukon Physical Environment

Year-round increases in temperature are predicted for the Yukon. Winters will warm more than summers and there will be increases in snow. Climate change will contribute to increasing sea levels in the Beaufort Sea which is already rising along the Yukon's coast. This sea level rise, coupled with an increasing number and size of summer storms, will cause increased erosion and flooding in coastal areas. The melting of permafrost will increase the occurrence of landslides and will impact local hydrology. Run-off levels and peak flows are predicted to rise.

Predicted Changes in Yukon Natural Ecosystems

Changes in vegetation communities are expected to occur which would mean more forest and less tundra in the Yukon. This change would result in a loss of habitat for some plant and animal species and a gain for others. In particular, rare species at the edge of their range, or those species unable to adapt, may be threatened. Due to changes in snow and seasonal patterns, the distribution and reproductive success of ungulates (i.e., caribou, moose) may be altered. Warmer temperatures should bring increased productivity in northern fish spawning areas, however, this change may be offset by deteriorating conditions in the marine environment. Some freshwater species may increase due to greater productivity in warmer waters, but there also could be deterioration of stream habitat related to changes in water flows.

Predicted Changes in Yukon Economic Sectors, Managed Ecosystems, and Lifestyles

Aboriginal lifestyles are strongly tied to resources on First Nation traditional lands. Impacts of climate change on distribution and abundance of fish and wildlife resources could affect the economic and cultural practices of aboriginal communities. Overall, the impact of climate change should be positive for agricultural production in the Yukon. An increase in the length of the growing season would allow production of crops that cannot be produced now in the Yukon (especially grain). Predicted changes in stream flow would affect the generation of hydro-electric power.

2.7 Climate Change: What Are We Doing About It?

2.7.1 Commitments to address Climate Change

As noted in the 1995 SOE Report, Canada was one of over 162 countries to sign the *United Nations Framework Convention on Climate Change* at the Rio Earth Summit in June of 1992. The aim of the international agreement is to stabilize emissions of greenhouse gases at 1990 levels by the year 2000. The agreement calls for developed countries that are party to the agreement to adopt national policies and take corresponding measures on the mitigation of climate change to meet this goal.

In February of 1995, Canada's environment and energy ministers approved the *National Action Program on Climate Change.* The document provided a number of strategies for government, the private sector and other organizations to help Canada meet its target to reduce greenhouse gas emissions. Despite this initiative, a 13% growth in Canadian greenhouse gas emissions from 1990 to 2000 is expected unless new initiatives are introduced to control emissions.[24]

Since the Rio Earth Summit in June of 1992, the countries who signed the Framework Convention on Climate Change have met on three separate occasions. Based on scientific information provided at the first meeting, it was concluded by the Parties that simply reducing greenhouse gas emissions to 1990 levels by year 2000 would be insufficient in terms of meeting the ultimate objective of the Framework Convention. The Parties therefore agreed to begin work on a process for action beyond the year 2000.

In December of 1997 the Parties meet in Kyoto, Japan to look into the possibility of strengthening commitments through the adoption of a protocol or other legal instrument to address emissions in the post-2000 era. On December 11, 1997 the Parties reached an agreement which calls for industrialized countries to reduce their collective emissions of six greenhouse gases by 5.2% by 2008 to 2012. These reductions would be calculated as an average over the five years and would be measured against emissions from 1990 and 1995.

To meet the requirements of the Protocol, the Parties can reduce greenhouse gas emissions through energy efficiency improvements and by adopting measures to influence energy use. Since trees act as carbon "sinks" in that they absorb carbon dioxide from the atmosphere, the effect of deforestation and the planting of new trees will also be factored into the equation.

The Protocol will be opened for signature for one year from March 16, 1998 and will enter into force once it has been ratified by at least 55 countries representing 55% of the total 1990 emissions from developed countries.

Municipal Action on Climate Change

The Canadian Federation of Municipalities has adopted an environmental policy (the *Canadian Declaration on Climate Change*) which includes a recommendation that municipalities reduce their carbon dioxide emissions by 20%. The Federation has joined forces with the International Council for Local Environmental Initiatives and encourages municipalities in Canada to adopt the *Canadian Declaration on Climate Change.* On January 9, 1995 the Whitehorse City Council unanimously voted to adopt the declaration.

City of Whitehorse Energy Efficiency Projects

In it's five-year capital plan (1998-2002), the City of Whitehorse has included a budget of $475,000 for energy management initiatives. Some of the recent energy efficiency projects undertaken by the City include:

- *A new ceiling in the Stan McCowan Arena, which caused a 25% reduction in the ice plant power bill. Energy-efficient lighting was installed for an additional 12% saving.*
- *Energy efficiency investments at the City's new sewerage facility which are expected to pay back within the first quarter (five years) of the facility's life.*
- *A consultant was hired to conduct energy audits in six City facilities (two arenas, the swimming pool, municipal services building, two fire halls, and City Hall) to determine energy use and potential for savings. Preliminary estimates show that energy consumption has been reduced by about 15%.*
- *The City ensures that equipment and products such as motors, lighting, and office equipment, are replaced with more energy-efficient products. Energy efficiency is also being considered in the design and construction of new municipal facilities.*
- *The boiler sequence has been changed at the Crestview pump house, with an estimated annual fuel savings of $7,000. This work will also be completed at the McIntyre Creek station, with estimated annual fuel savings of $12,000.*
- *The boiler operations in the municipal services building have been changed, resulting in annual fuel savings of $6,000.*

2.7.2 Yukon Energy Saving Programs and Initiatives

A variety of energy saving programs and initiatives is ongoing in the Yukon. For instance, in seven Yukon schools a one-year pilot program has been initiated to reduce energy use by 14.5 percent. This program is expected to result in 10 percent savings for the Education Department. Recently the Government of Yukon has developed its own Energy Plan to improve energy efficiency in its government buildings. The Yukon Housing Corporation has launched a program called "Energuide to Housing in Canada", with help from Natural Resources Canada. Energy audits will show homeowners what improvements should be made and the resulting monetary savings to be gained. Lastly, Yukon Energy Corporation (YEC) is currently taking steps to improve energy efficiency in their own facilities. For example, improvements to a propane heating system at YEC's generating facility in Whitehorse reduced the reliance on electric heat. Also, the utility is looking at ways to reduce station service loads at Aishihik.

2.7.3 Wind Generated Electricity

For some time now, the Yukon government has been seeking alternatives to using diesel to generate electricity. Wind generated electricity involves no emissions of greenhouse gases or other pollutants into the atmosphere. Studies of the Yukon's potential for wind generated electricity suggest that wind velocities are greatest during the winter months which coincides with peak electricity demand. In 1993, the Yukon Energy Corporation (YEC) installed a commercial wind-turbine on Haeckel Hill near Whitehorse for experimental purposes. From August 1993 to July 1996 the Haeckel Hill wind-turbine produced approximately 675 Mwh of electricity. This is enough power per year (on average) to supply 23 non-electrically heated homes.[25]

2.7.4 Reducing Transportation Emissions: Public Transit and Active Transportation

Public transit is widely recognized as an environmentally friendly mode of transportation which offers an alternative to single-occupancy vehicles, such as automobiles and light trucks, which emit more harmful air emissions per passenger. In Canada, as much as 33% of carbon dioxide emissions comes from cars and light trucks.[26] In addition, about 90 per cent of the carbon-monoxide contamination in our air is from motor-vehicle exhaust. Other pollutants emitted by vehicles include airborne particles, hydrocarbons, and nitrogen oxides.[27]

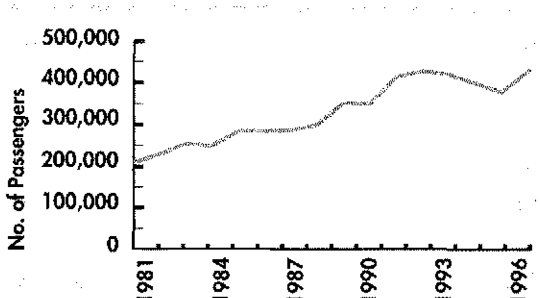


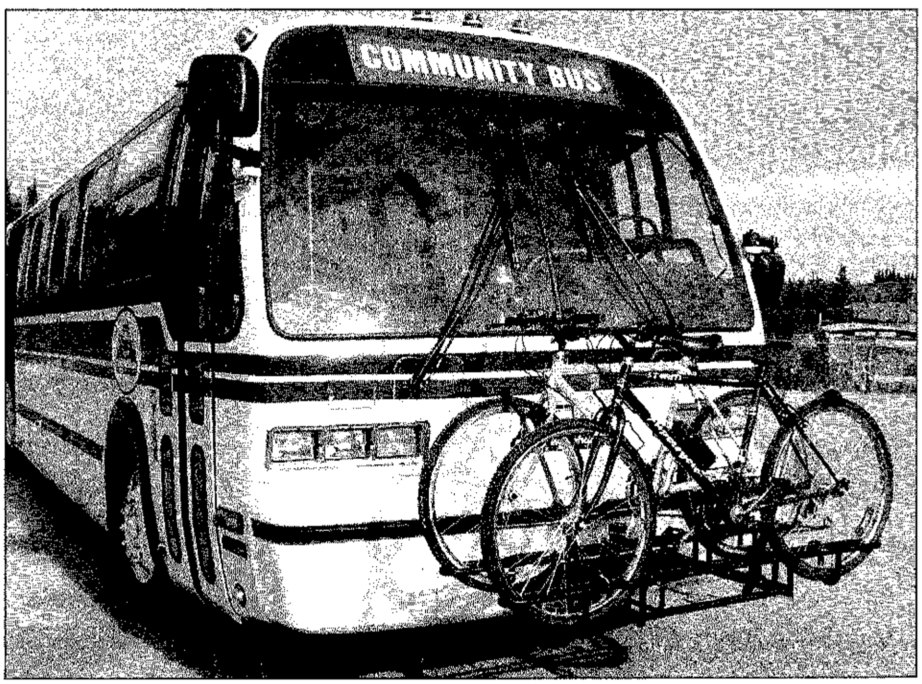
Figure 2.6

Whitehorse Transit Ridership 1981-1996

The City of Whitehorse is sparsely populated which presents a significant challenge to maintaining a public transit system which is both efficient and cost-effective. The City operates 14 buses, four of which were purchased in 1997. Figure 2.6 demonstrates that Whitehorse Transit ridership has generally been increasing since 1981. Consistent with national transportation trends,[28] ridership was down slightly beginning in 1992. Recently, however, those numbers have begun an upward climb. With a new Transit Master Plan in progress, the City hopes to increase its ridership through routing changes and new service guidelines. To ensure that the new Master Plan meets the needs of the Whitehorse community, public meetings were held and surveys were carried out in 1997. As a result, increased service is being proposed for certain locations such as the downtown core, hospital, airport and Yukon College (night time runs for evening classes). A new transfer location will promote greater efficiency, safety and security. Other objectives of the proposed routing and scheduling changes include providing consistent frequency of service to all areas, improving on-time performance, and maximizing route efficiency.[29]

One innovative Transit proposal involves securing bike racks to the front of buses to transport bicycles. Twelve racks would be purchased each of which can hold two bicycles. Passengers would be responsible for loading and unloading the bicycles themselves and would pay regular fare. This proposal supports 'active transportation' which the Yukon Sport and Recreation Branch defines as "getting Canadians to drive less and find active, alternative means of getting around such as transit, walking, biking, or skiing"[30]. Furthermore, these activities create little or no air emissions.

To promote active transportation, participants from across the Yukon attended a two-day workshop in April, 1997 on "Transportation and Trails: The Healthy and Active Alternative" in the City of Whitehorse. This event coincided with the opening of the Trans-Canada Trail and provided information on transportation alternatives and their health and environmental benefits. Actions and options which support active transportation were identified. It was hoped that these discussions would foster community ownership and responsibility for transportation and health choices.



3.0 OZONE LAYER DEPLETION

3.1 Why is it Happening?

Unlike ozone near the earth's surface, which is a harmful pollutant, ozone in the stratosphere (15 to 35 kilometers above the earth's surface) provides a protective shield from the sun's damaging ultraviolet rays. Emissions of industrial chemicals containing chlorine and bromine have been released over the past several decades and have been transported into the stratosphere where they attack and destroy the ozone layer. These harmful chemicals are known as 'ozone-depleting substances' (ODSs) and are used in air conditioners, refrigerants, foams, aerosols, solvents and fire extinguishers. Chlorofluorocarbons (CFCs) account for more than 80 per cent of all ODSs.[31]

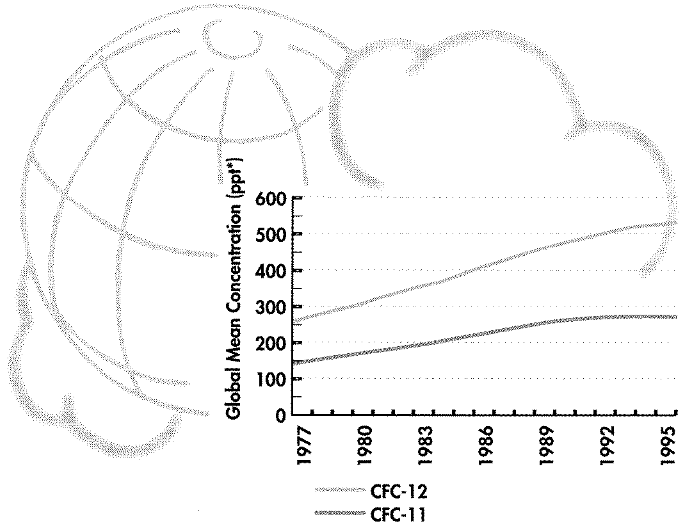


Figure 3.1

Global atmospheric concentration of ozone depleting substances

**ppt: parts per trillion (10^{-12})*

CFC-11 and CFC-12 are the most commonly used chlorofluorocarbons. They account for half of the ozone-depleting chlorine in the atmosphere. Since measurements began in 1977, global atmospheric concentrations of CFC-11 and CFC-12 have been increasing (Figure 3.1). However, growth rates have decreased significantly since 1989 showing the impact of initiatives at the international level (Section 3.4.1). If trends continue, total CFC levels in the atmosphere are expected to peak by the end of the decade and then begin to decline slowly. Recent information suggests that the reservoir of CFCs will persist in the atmosphere for up to 50 years.[32]

3.2 More UV-B Radiation is Cause for Concern

Depletion of the ozone layer means that living organisms are exposed to harmful ultra-violet radiation (UV-B) which can cause serious damage to living tissue. For humans, increased UV-B exposure has been linked to suppression of the immune system, premature skin aging and increased occurrences of sunburn, skin cancer and cataracts. Elevated levels of UV-B radiation can also decrease the yield from agricultural crops such as wheat, rice, corn and soya beans. In addition, growth rates of forests and aquatic life near the surface of the ocean may be disrupted by a change in the amount of this type of radiation.[33] No research directly related to UV-B radiation has been conducted in the Yukon.

3.3 Measuring Ozone Layer Thickness and UV-B Radiation

Up until recently, there has been no monitoring of the ozone layer or UV-B radiation in the Yukon. However, in 1997 the weather station at Sheep Creek in Ivvavik National Park was outfitted with an UV-B sensor. This station was established as part of the Parks Canada monitoring program and data are transmitted directly to Environment Canada via satellite.[34] These data should prove useful for future Yukon state of the environment reporting. Until more data are available, it is helpful to examine Canada-wide trends and monitoring data from stations that are closest to the Yukon.

Environment Canada measures the annual average thickness of the ozone layer over Canada. The thickness of the ozone layer is reported in 'Dobson units'. One hundred Dobson units represents a quantity equivalent to a 1-mm thick layer of ozone at sea level. Since 1979, there has been a decrease in the amount of stratospheric ozone over the entire globe. There was a 4-6% decrease per decade in mid-latitudes and a 10-12% decrease per decade in higher latitudes. In 1994, Canadian levels were quite high compared with the previous eight years which scientists attribute to meteorological variation. In 1995 these levels dropped and the 'hole' over the Antarctic was one of the longest lasting ever recorded. For the first eight months of 1996, total stratospheric ozone levels were 5.1% below pre-1980 values.[35]

Figure 3.2

Canadian stratospheric ozone levels, 1957-1993

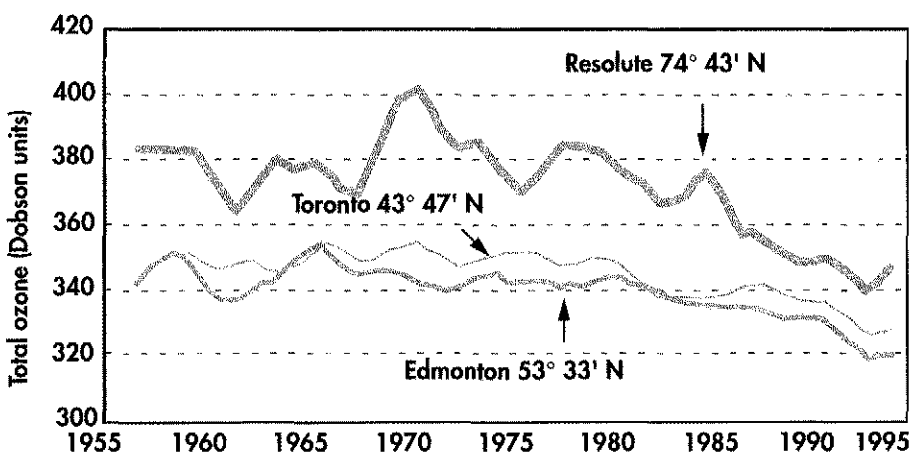
Notes:

a) *Measured by Brewer ozone spectrophotometer from the ground 1994 measurements use data from January to August.*

b) *This graph represents long-term trends in Canadian stratospheric ozone levels. The effect of short-term season variations and quasi-biennial oscillations of stratospheric wind patterns have been largely removed by statistical smoothing.*

Source:

Atmospheric Environment Service, Environment Canada, 1994c.



The World Ozone and UV Data Centre of Environment Canada in Downsview, Ontario collects data from stations across Canada .[36] The closest of these stations to the Yukon is Edmonton. However, since latitude is the most important determining factor for total ozone levels, Edmonton is more representative of South Yukon, whereas Resolute is more representative of North Yukon.[37] Figure 3.2 shows a general downward trend in total ozone levels for Resolute, Toronto, and Edmonton from 1955 to 1995 which is consistent with Canadian and global trends.

3.4 Ozone Depletion: What Are We Doing About It?

3.4.1 International Cooperation

Evidence that CFCs were depleting the ozone layer prompted the United Nations Environment Programme to reduce the global production of CFCs through the Vienna Convention for the Protection of the Ozone Layer (1986), and the Montreal Protocol on Substances that Deplete the Ozone Layer (1987).[40] To date, 155 countries have signed on to the revised international agreement under which they committed to phasing out all CFCs, carbon tetrachloride and methyl chloroform by January 1, 1996. Production and import of halons ceased on January 1, 1994 and will be phased out by the year 2030[41]. On September 16, 1997 representatives from across the world gathered in Montreal under the theme "Renewing Our Commitment: Celebrating Our Progress" to mark the 10th anniversary of the Montreal Protocol.[42] A study commissioned by Environment Canada and released at this meeting announced that the anticipated outcome of meeting the requirements of the Protocol to protect the ozone layer will produce about $224 billion in net economic benefits by the year 2060. Furthermore, it was estimated that the protocol will save almost a third of a million lives over the same period by reducing the incidence of sun-induced skin cancer.[43]

Unprecedented Ozone Layer Thinning Over Canadian Arctic

The thinning of the ozone layer over the Antarctic has been well documented. In the 1995 Yukon State of the Environment Report[38] it was reported that the rate of ozone depletion in the Arctic is much slower than that occurring in the Antarctic. However, new scientific data is suggesting otherwise.

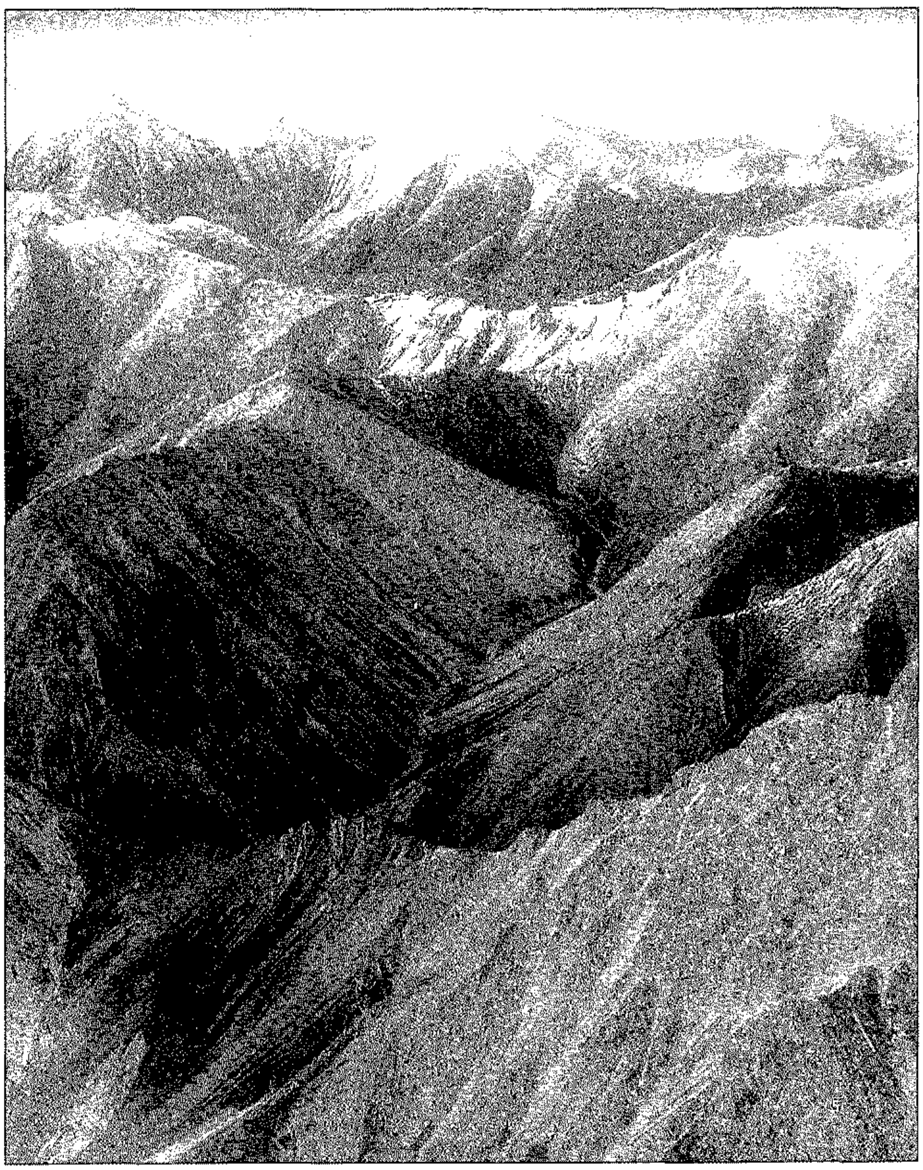
In the Spring of 1997, Environment Canada announced that ozone values over the Canadian Arctic were the lowest ever recorded for March. Data from U.S. satellites and Canada's ground stations and balloon-borne ozone sensors showed that ozone values were as much as 45 per cent below normal (pre-1980 average). The ozone layer over the Arctic in 1997 was below 3.0 mm, while the normal value for the layer should be 4.5 mm. For some days, the concentration in the 12-24 km altitude range at Eureka and Alert on Ellesmere Island was more than 60 per cent below normal. Scientists believe that the thinning of the Arctic ozone layer was due to unusual spring wind patterns in 1996 and 1997 which create conditions necessary for ozone depletion. It is not clear whether the unusual wind patterns are connected with global warming or are rare natural events.[39]

3.4.2 Yukon Ozone Depleting Substance (ODS) Regulations

The Yukon's *Ozone Depleting Substance Regulations* came into effect on February 27, 1996. These laws govern the release, possession, purchase, servicing and disposal of ozone depleting substances and equipment containing them.

Release into the environment of ozone depleting substances from equipment such as air conditioners, refrigerators and fire extinguishers is prohibited. Those who work with these substances or equipment must hold a registration permit issued under terms and conditions set by the Minister of Renewable Resources. Records must be kept and the servicing of air conditioners, refrigerators and fire extinguishers must meet performance standards and Codes of Practice referred to in the regulations. The ozone depleting substance must be recovered before this type of equipment is disposed of. An alternative is to take the equipment to a waste disposal site operated by the Yukon government or by a municipality which has made special arrangements for storage and disposal.

Contravention of these regulations results in penalties ranging from $50 to $200 for less serious offences. For more serious offences that result in court actions, maximum penalties under the Environment Act range from $200 or six months in jail to $3, 000, 000 or a five year jail term.[44]



4.0 ATMOSPHERIC TRANSPORT OF CONTAMINANTS TO THE ARCTIC[45]

4.1 Contaminants found in the Canadian Arctic

In the 1970s and 1980s scientists wanted to compare contaminant levels in polluted southern areas to 'pristine' areas such as the Canadian Arctic. To their surprise, contaminants were found in the air, water, animals, plants and people in the North. To address the issue of long range transport of contaminants, the Arctic Environmental Strategy Northern Contaminants Program was begun in 1991. This program was developed through consultation with the scientific community, northern aboriginal organizations, government departments and northern communities. A final report was released in 1997 and has important implications for the Yukon.

4.2 How Do Contaminants Get to the Arctic?

Contaminants are transported to the Yukon and the Canadian North by air, oceans, ice and rivers. Transport by *air* is the most important of these pathways. One group of contaminants transported by air are human-made chemicals called 'organochlorines'. Some well-known examples of this type of contaminant are PCBs and pesticides such as DDT. Sources of organochlorines within the Canadian Arctic are considered very minor. The way in which these contaminants travel by air has been called the 'Grasshopper Effect'. In warm temperatures, organochlorines evaporate, move in the air to colder places, and then condense and fall to the earth. Since major air currents tend to move toward the Arctic, these contaminants eventually reach the Canadian North. In the absence of warm temperatures, the contaminants become 'trapped' since there is little opportunity to evaporate. Once in the Arctic, organochlorines can fall on the land, ocean, lakes and rivers, directly from the air, or in rain or snow.

4.3 Contaminants in the Food Chain

When organochlorines reach water or plant surfaces they can enter the food chain. They have several properties which make them dangerous to living organisms. First, organochlorines are not easily changed to less harmful forms in the environment (they are persistent); second, they can can be stored in living tissue; and third, they are not easily broken down or removed once in an animal's body. If an animal continues to eat foods with organochlorines, contaminants levels will build up over time. This effect is known as 'bioaccumulation'. In addition, concentrations of contaminants increase with each step from prey to predator in a process called 'biomagnification'. An animal at the top of a food chain, such as a polar bear, would end up with higher concentrations of contaminants than the marine mammals and fish that it eats. Different kinds of animals have different levels of contaminants due to several factors which include feeding habits, migration, age and fat content.

4.4 Differences Among Areas, Changes Over Time

Organochlorines are evenly distributed across the Arctic. This uniformity is a result of the contaminant transport route which is mainly by winds coming across the North Pole from Russia in the winter and from the south in the summer. Lighter contaminants travel faster by air than heavier contaminants and therefore arrive in the Arctic first.

Some studies suggest that the levels of organochlorines in the Canadian Arctic are likely lower than other industrialized parts of the world. For instance, belugas from the St. Lawrence have 12 times more PCBs than Arctic beluga, 3 to 4 times more of the pesticides toxaphene and chlordane, and almost 30 times more DDT. Not enough data have been collected over a long enough period of time to say anything definite about how contaminant levels in wildlife are changing over time. However, it is possible to look at ice, snow and sediment cores to see changes in the amounts of contaminants being deposited in the north. Changes in the levels of these contaminants are usually linked to changes in production and use of contaminants in other parts of the world. For example, examination of glaciers shows no evidence of PCBs until after the 1960s. Given that PCBs only became widely used during the period of 1950s to 1970s, and the time lag associated with the transport of the contaminant to the north, the glacier record makes sense.

4.5 What About Humans?

Contaminant levels in people vary according to their diet. People whose diets include animals higher up in the food chain tend to have higher contaminant levels than people whose diets consist mainly of plants and plant-eating animals. People who consume high quantities of marine mammal tissue tend to be exposed to higher levels of organochlorines than people who eat land animals and fish. In the Yukon, only the Inuvialuit eat significant quantities of marine mammals.[46] However, it is generally thought that the benefits of traditional/country food outweigh the possible risks of long-term, subtle effects associated with current levels of contaminants in these foods. For aboriginal communities, traditional/country food represents a way of life and contributes to cultural, spiritual and mental well-being. In addition, this food is the most economical and healthy diet available to people in the North.

4.6 What Are We Doing About It?

International cooperation is the key to stopping the release of contaminants throughout the world and eliminating food chain contaminants in the North. Currently eight Arctic countries (Canada, Denmark, Iceland, Norway, Sweden, Finland, Russia, and the USA) cooperate under the Arctic Environmental Protection Strategy to examine and act on environmental issues in the North. As part of this strategy, the Arctic Monitoring and Assessment Program deals with contaminants. In 1996, the Arctic Council was formed which allows Arctic countries to work together on common issues of concern, one of which is the environment. Canada has also been working with countries in the southern hemisphere to find ways to stop their use of contaminants. This type of work will also be combined with international laws at the global level. Negotiations will begin in 1998 and should take about three years to complete.

5.0 LOCAL AIR POLLUTION ISSUES

5.1 Whitehorse Urban Air Quality

5.1.1 Public Perception

Information about public perception of air quality is sometimes valued as highly as scientific measurements of air pollution. Results of the 1996 City of Whitehorse Citizen Survey indicated that most residents are concerned about air quality. In the survey, 384 respondents across Whitehorse were asked "What do you think is the biggest environmental issue in Whitehorse?" 'Air quality' was cited more often than 'water quality/conservation' and 'green space protection', and was second only to 'waste management'.[47]

5.1.2 National Air Pollution Surveillance Station in Whitehorse

Whitehorse ambient air quality is monitored through the National Air Pollution Surveillance (NAPS) program. The Whitehorse monitoring station, operated jointly between the federal and territorial governments is part of a network of air monitoring stations across Canada designed to monitor and assess ambient air quality in urban regions. In 1993, the operation of the Whitehorse monitoring station was transferred from Environment Canada to the Yukon government in an effort to harmonize with other jurisdictions. With the station now located at the Andrew A. Philipsen Law Centre in downtown Whitehorse, Renewable Resources provides equipment calibration, maintenance, data retrieval and compilation. Environment Canada provides the equipment and conducts analyses. The downtown Whitehorse station monitors concentrations of carbon monoxide (CO), nitrogen dioxide (NO_2), nitrogen oxide (NO), total suspended particulates (TSP), particulate lead and sulphate.[48]

5.1.2.1 Lead

Measures to control lead in vehicle exhaust have proven to be very effective. Lead additives in gasoline were phased out of use in Canada between 1974 and 1990. As a result, the lead contained in air particles has shown a dramatic decline across Canada and in the Yukon (Figure 5.1). In 1994, the average particulate lead level in the air in downtown Whitehorse was so low that the sensitive instruments could detect no lead. This is the lowest annual mean since 1978.

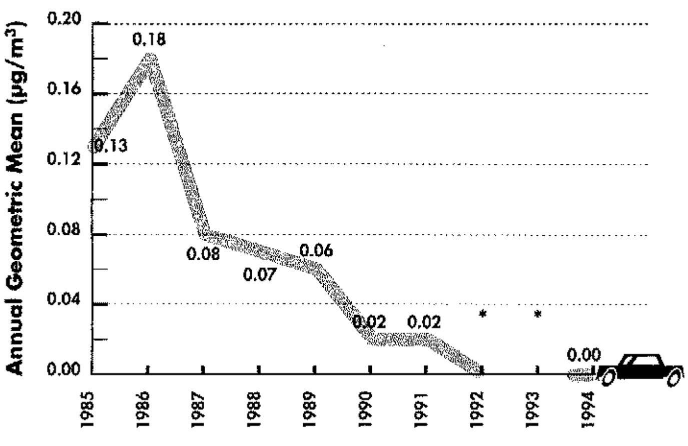


Figure 5.1

Lead in air, downtown Whitehorse (1985-1994)

**Values for 1992 and 1993 were not available due to insufficient data.*

5.1.2.2 Nitrogen Dioxide and Carbon Monoxide: High Events and Seasonal Variation

Carbon monoxide (CO) is a common air pollutant and is usually present in the atmosphere at low concentrations. At higher levels, this colourless, odourless gas can represent an acute health risk. Any combustion process where carbon-containing organic material is burned without sufficient oxygen will produce carbon monoxide. Motor vehicles, especially poorly tuned ones, are the major source and account for three-quarters of these emissions. Other sources include the use of fuel for generating electric power and home heating with firewood.

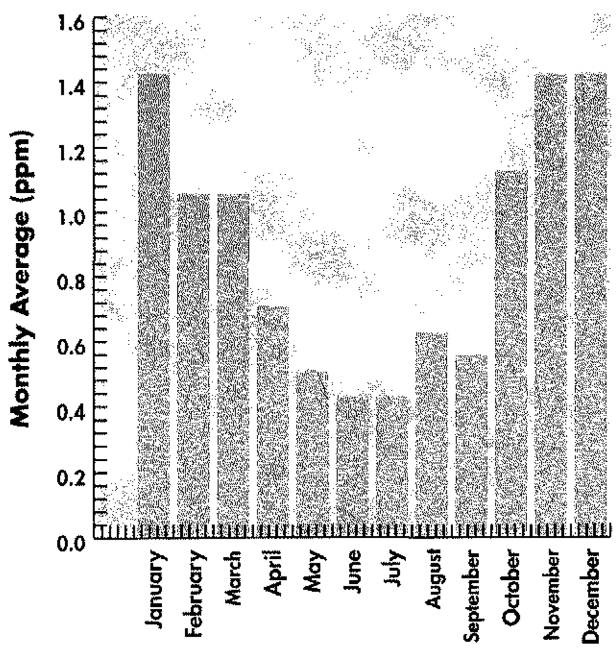
Nitrogen dioxide (NO_2) is a reddish-brown gas that people can smell. At high concentrations, this pollutant can affect human health, vegetation, materials and visibility. High temperature combustion of fuel from transportation accounts for more than half of the total emissions of nitrogen dioxide (NO_2), while more than 30% is derived from stationary fuel combustion such as in homes, businesses, factories and power plants.[49]

Both of these parameters vary seasonally within the City of Whitehorse (Figure 5.2 and Figure 5.3). Elevated concentrations of these two pollutants are experienced in the mid-winter (CO) and late winter (NO_2). In the winter, warmer air above the city often traps the colder air at the ground level for hours or days. During these 'temperature inversions', gaseous pollutants and particles from heating and transportation sources generally build-up in the air until winds increase and blow them away. It is not clear why there were high concentrations of NO_2 in the month of May.

Figure 5.2

*Seasonal Variation of Carbon Monoxide (CO) in Whitehorse 1985-1996**

**Data were unavailable for 1992-1994. During this period, operation of the NAPS Whitehorse air monitoring station was transferred from Environment Canada to the Yukon Government. 1995 data are being compiled in Ottawa and will be available in 1998. 1996 data were compiled by Renewable Resources, Yukon Government for this report (ppm) is parts per million.*



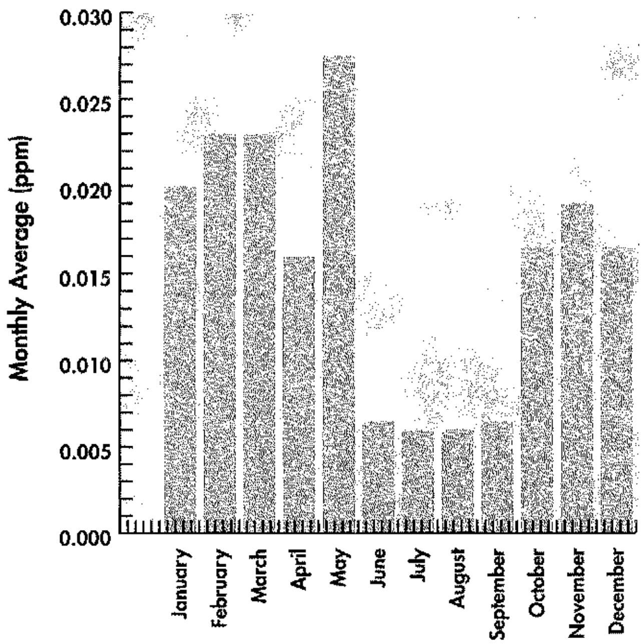


Figure 5.3

*Seasonal Variation of Nitrogen Dioxide (NO_2) in Whitehorse 1985-1996**

**Data were unavailable for 1992-1994. During this period, operation of the NAPS Whitehorse air monitoring station was transferred from Environment Canada to the Yukon Government. 1995 data are being compiled in Ottawa and will be available in 1998. 1996 data were compiled by Renewable Resources, Yukon Government for this report. Ppm is parts per million.*

Of interest is how the levels of these pollutants compare to the National Ambient Air Quality Objectives. These objectives were developed by the Canadian government and are based largely on considerations of human health. During 1996 there were no 'high NO_2 events' or periods where the air quality objectives for NO_2 were exceeded. High NO_2 events are 24-hour periods when NO_2 levels put air quality in the 'poor' range as defined by the National Air Quality Objectives. The 1995 State of the Environment Report noted that a number of high NO_2 events occurred during 1989 and 1991. However, instrument error may be the cause of these unusually high readings.

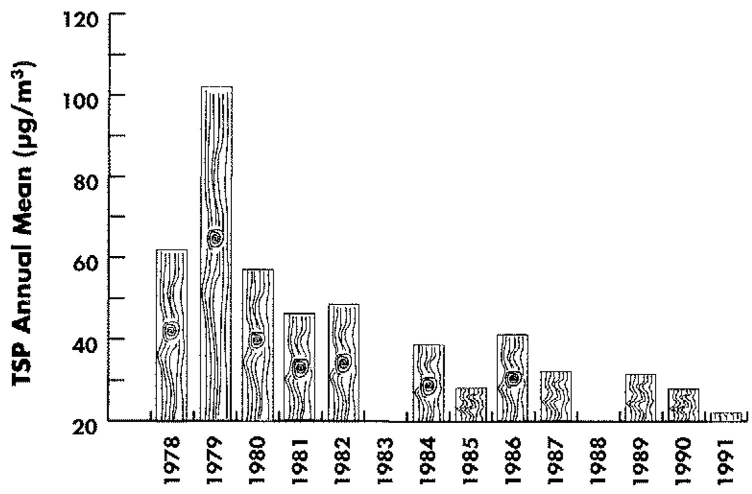
5.1.2.3 Airborne Particles

As mentioned earlier, the Whitehorse air monitoring station measures total suspended particulate (TSP) which is the name given to airborne particles which include smoke, fumes, dust, and pollen. These particles can range in size from 0.1 to 100 microns. In Whitehorse, the major sources of TSP are woodsmoke, transportation and incineration. Natural sources include windblown dust and forest fires. Particles in the air can reduce visibility, cause soiling of buildings, clothing, etc., and can affect human health (*see page 21*).

The annual average level of TSP in Whitehorse has declined steadily since the 1970s (Figure 5.4). However, there are occasional 24-hour periods when TSP levels exceed the national air quality objectives. These events are usually related to woodsmoke, vehicle exhaust, and ground-based temperature inversions which result in air stagnation. In Whitehorse, highest TSP levels occur in the early spring when dust is blown through the city streets just after the snow has melted.[50] No recent TSP data from the Whitehorse station were available for this report. The data gap for 1992-1994 reflects the transfer in operation of the Whitehorse air monitoring station from Environment Canada to the Yukon government. The 1995-1996 data are currently being analyzed and summarized by Environment Canada in Ottawa.

Figure 5.4

Total Suspended Particulates (TSP) levels, Whitehorse



5.2 Woodsmoke

In the Yukon, the use of wood as principle heat source is much higher than other parts of Canada. In the 1986 Census, 43 % of the Yukon population indicated that they use wood as the principle method to heat their homes (36.2 % higher than the Canadian average).[51] Although Statistics Canada no longer collects information on heating methods, data taken from wood cutting permits suggests that the use of wood as a heat source was rising steadily between 1982 and 1988. During this period, wood's share of all Yukon energy sources rose from 3% to 7% , effectively displacing part of oil's share in the residential space heating market. Since that time, the amount of wood being used for home heating has been falling. The reasons for this trend may be related to cost. Lately the price of wood has been rising while the cost of oil has been falling. New advances in heating technology have also created energy efficient systems that are capable of producing more heat with less fuel making this heating option more attractive to some home owners.

Wood burning results in the release of a number of pollutants into the atmosphere including carbon monoxide, nitrogen oxides, organic gases, and airborne particles.[52] Wood smoke has been a persistent problem in the Riverdale subdivision of Whitehorse, mainly due to the occurrence of temperature inversions. In 1986, the City of Whitehorse enacted a bylaw to prevent wood burning when total suspended particulate levels are high. No burn periods are enforced when the total suspended particulate matter exceeds 110 micrograms per cubic metre. Between 1992 and 1996, the annual number of no burn periods in Riverdale ranged from one to three. In January 1997, the City amended the bylaw to require all wood stoves installed after March 1, 1997 to meet emission standards of the United States Environmental Protection Agency and Canadian Standards Association. Furthermore, the limit at which a no burn period is called was lowered from 120 to 110 micrograms per cubic metre.[53]

Based on the Riverdale experience, the City of Whitehorse recognized that potential air quality impacts of further residential development in the lower Porter Creek area was an important consideration. For this reason, TSP monitoring was carried out in upper Porter Creek (Tamarack Dr.) and lower Porter Creek (Transportation Canada site) between November 1995 and March 1996. Based on observed TSP levels, this study concluded that

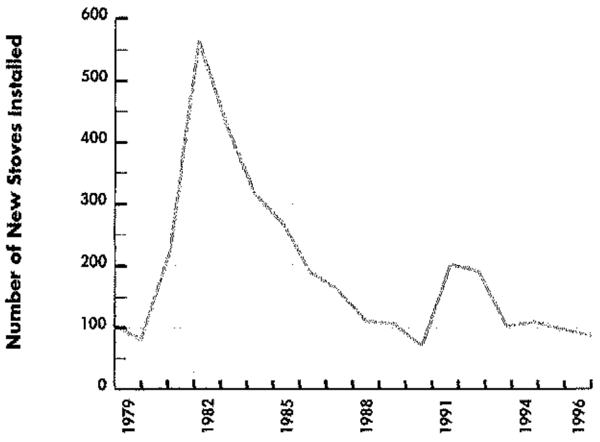


Figure 5.5

Number of New Stoves Installed (Pellet and Wood)

there would be potential air quality problems if Lower Porter Creek was developed without considering the impact of residential wood burning. Future considerations could include the density of the new development, the type of heat sources to be used and the retention of forest cover.[54]

5.3 Open Burning of Garbage

The Yukon remains one of the few areas in Canada where the burning of garbage is unregulated.[61] Burning of garbage is a concern because it can result in air pollutants such as dioxins, furans, metals, acid gases and carbon monoxide.[62] In the Yukon, the Yukon Department of Community and Transportation Services (C&TS) operates approximately 20 waste sites, the federal Department of Highways operates five, while eight incorporated Yukon communities operate their own waste sites. Prior to 1997, waste from all Yukon communities, with the exception of Whitehorse was either tipped into natural depressions, burned and covered, or tipped into a trench, burned, compacted and then backfilled. C&TS follows a set of guidelines for the management and operation of waste disposal sites. On average, household garbage is burned once a week. Of those sites operated by C&TS, the Mt. Lorne site is the only site with a confinement structure, which was erected for experimental purposes. C&TS found that while this structure provided a more effective burn and better animal control, it provided no control of fumes.[63]

In response to an inquiry on behalf of the Association of Yukon Communities regarding municipalities' position on open burning at landfill sites, the Whitehorse City council voted against this practice.[64] The Yukon Government has also recently decided to prohibit the practice of burning garbage at the Mt. Lorne site. Haines Junction and Dawson have plans to phase out the burning of garbage as well.

Health Effects of Wood Smoke and Fine Particles

Evidence is mounting to suggest that wood smoke is harmful to human health. Wood smoke can cause a decrease in lung function, and can aggravate heart conditions and respiratory illnesses such as asthma, emphysema, pneumonia, and bronchitis. Particularly susceptible are infants, children, pregnant women, senior citizens and cigarette smokers.[55]

Wood smoke is a source of airborne particles. Within the last few years it has become clear that fine particles, those less than 10 microns in diameter, pose a threat to human health. In 1995, a researcher with the U.B.C. Department of Medicine estimated that increases in fine particles pollution cause 82 extra deaths in BC every year, and 146 hospitalizations due to asthma, and lung and heart disorders.[56] Some fine particles are released directly from sources into the air while others are formed from physical and chemical reactions involving gases.[iv]

Recently, there has been increasing interest by researchers in even finer particles, those less than 2.5 microns in diameter. These particles are too small to be filtered by the nose and upper respiratory system, so they wind up deep in the lungs. Poisonous and cancer-causing chemicals often enter the lungs by 'piggy-backing' onto these tiny particles.[57] In light of these scientific findings, a national air quality objective for fine particles is currently being developed by Health Canada and Environment Canada.[58] As of February 1997, a fine particles monitor had been installed at the Riverdale monitoring station in Whitehorse. This monitor is on loan from Ottawa and began operating in the winter of 1997/98. Of particular interest will be establishing the relationship between levels of TSP and fine particles at this location.[59] Watson Lake has also started conducting its own TSP sampling under the guidance of Environment Canada.

[iv] It is of interest to note that diesel engines emit 30 to 100 times more fine particles than gasoline-powered engines do. Source: The Lung Association, Hamilton-Wentworth and the Hamilton-Wentworth Air Quality Initiative. (1996) 'Helath Effects of PM_{10}" No. 1996-08-31

How Small is...?

- a micron or micrometre (μm) - one-millionth of a metre
- a raindrop - about 2,000 micrometres in diameter
- a period [.] - about 500 micrometres in diameter
- PM_{10} - 10 micrometres and smaller in diameter
- bacteria - about 0.3 to 10 micrometres in diameter
- $PM_{2.5}$ - 2.5 micrometres and smaller in diameter

5.4 Proposed Air Emission Regulations

Regulations are one effective tool that can be used to manage air pollution. The Yukon Department of Renewable Resources has developed *Draft Air Emission Regulations* under the Yukon *Environment Act*. The regulations propose to control the release of air contaminants from sources including motor vehicle exhaust, opening burning of wastes, and large industrial boilers, burners and engines. These draft regulations have undergone stakeholder review and are now being reviewed by the public before they become law.[65] Solid Waste Regulations developed under the Yukon *Environment Act*, also expected to be finalized by the end of 1998, may include requirements for the burning of garbage.

SOURCES OF DATA FOR FIGURES

Figure 2.1 and 2.2

Data provided by Liu, S. Environment Canada (Vancouver). Greenhouse gas emissions inventory estimates in the Yukon from 1990 to 1995.

Figure 2.3

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Figure 2.4

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Figure 2.5

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Figure 2.6

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Figure 3.1

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Figure 3.2

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Figure 5.1

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Figure 5.2 and 5.3

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Figure 5.4

Data available from Environment Canada National Air Pollution Surveillance (NAPS) Network Annual Summaries for period 1978-1991.

Figure 5.5

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