ALASKA LEGISLATURE COMMITTEE FILES 1985-1986 8672

3855 SCRA SB 48

731

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James O. Smith
Signature of Camera Operator

10/31/89
Date

(REV 8/78)

SB

418

Notice of hearing published Jan 25

Jan 31 - Asked Senator Ferguson - Mike Scott for bill back-up

Feb 1 - Ferguson/Scott brought mtl by. -

Steve Gilbertson or Teague - 15 minutes
3 communities and Arctic haze

Info from Mike Scott 2/1/85 — all contacted

3648 Clean Air

DEC Stan Hungerford 7660

Dr Glenn Shaw Univ of Ak
Geophysical Institute

call Steve Gilbertson C/Boro Juneau

Ak Environ Lobby Steve Highleman
Juneau
586-2345

SB 48

Feb 6 - Spoke w/ Hungerford - he will testify
DEC - State

FNSB - Heather Stockard, Envir Srvcs Dir.
Linda Anderson -- 586-1608 - Lobbyist for Fai.

DR. ~~Stan Hungerford~~ Glenn Shaw - Arctic Haze
will speak 8 to 10 minutes
Munis need to spend more money for research

U of A
Geophysical
ph 474-7558

DR Gunther Weller - did not reach

Jay Nelson - Ak Envir. Lobby will be present - doesn't desire to testify

Leonard Verrelli

STATE OF ALASKA
THE LEGISLATURE

POUCH Y · STATE CAPITOL
JUNEAU, ALASKA 99811
907-465-3800

LEGISLATIVE AFFAIRS AGENCY

LEGISLATIVE REFERENCE LIBRARY

May, 1988

Copies of minutes listed below were originally included in this file. The minutes are available on the STAIRS database CMPR. In order to save space copies of minutes have not been left in the files.

Mary Van Nimwegen

CRA 2-7-85 3:34pm

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPT. OF ENVIRONMENTAL CONSERVATION

OFFICE OF THE COMMISSIONER
POUCH O, JUNEAU, ALASKA 99811

Telephone:(907)
Address:
465-2[illegible]00

March 1, 1985

The Honorable Edna Armstrong-DeVries
Chair, Senate Committee on
Community and Regional Affairs
Pouch V
Juneau, Alaska 99811

Dear Senator Armstrong-DeVries:

Thank you for the opportunity to comment on SB 48 related to grants for community air quality monitoring and abatement programs. Mr. Stan Hungerford reported to me about the hearing you held February 7th. Since it is apparent that a letter of intent and/or modifications to the act may be necessary, I offer the following comments for your review and consideration:

1) Specify that the department promulgate regulations similar to the language in AS 46.06.130 referring to the Litter Program grant authority.

2) Define the types of projects eligible for funding similar to the language in AS 46.06.120 referring to the Litter Program grants, or AS 46.03.03(b) referring to water supply, sewerage, and solid waste facilities grants.

3) Insert language in what is currently line 14, indicating that the department may enter into contractual agreements with an appropriate consulting firm on behalf of a community whose project merited funding in those cases where a community was unable to manage a contract of this technical nature, or has requested the department manage it for them, similar to that in AS 46.07.040 related to the Village Safe Water facilities grant program.

4) Limit or prohibit the use of funding, such as use of project funds to pay routine community administrative costs, similar to that in AS 46.03.030(d), related to construction grants.

5) Limit the amount of funds to be awarded to any one project or community.

6) Indicate how to allocate the total funds. For example, the following range of distribution would give the department guidance on how the legislature would like air quality problems addressed.

30-40% air quality and meteorological monitoring where risk of human health has a high potential
10-20% monitoring for potential environmental damages
10-20% basic research in atmospheric sciences applicable to high latitudes
10-20% to develop control strategies
20-30% to implement a local control strategy
10-20% to support staffing of an approved local program
10-20% development of innovative control technologies.

We would be glad to work with you to establish such allocation levels if you desire.

7) If funding for staffing a local program is desired, specify the financial commitment required of the community, such as "matching" a specific percentage or budgeting to assure continuation of the program after the grant period ends, similar to that in 46.03.030(e) related to construction grants.

Sincerely,

Bill Ross

Bill Ross
Commissioner

SWH6/sm

cc: Senator Arliss Sturgulewski
Senator Vic Fischer
Senator John Coghill
Senator Frank Ferguson

WORK DRAFT WORK DRAFT Rec'd 2/21/85 WORK DRAFT

Ford
2/21/85 ✓

Original sponsors: Ferguson, Kelly,
Sturgulewski and Coghill

Funding Information
General Fund $10,000,000
Other Funds - 0 -
$10,000,000

IN THE SENATE

BY THE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

CS FOR SENATE BILL NO. 48 (C&RA)

IN THE LEGISLATURE OF THE STATE OF ALASKA

FOURTEENTH LEGISLATURE - FIRST SESSION

A BILL

For an Act entitled: "An Act making a special appropriation to the Department of Environmental Conservation for payment as grants to municipalities and unincorporated communities for clean air studies, abatement of air pollution, [and development of technology to reduce air pollution;] and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. The sum of $10,000,000 is appropriated from the general fund to the Department of Environmental Conservation for payment as grants to municipalities and unincorporated communities for clean air studies, abatement of air pollution, [and development of technology to reduce air pollution.]

* Sec. 2. The appropriation made by this Act shall be disbursed in accordance with AS 37.05.315 - 37.05.325.

* Sec. 3. This Act takes effect immediately in accordance with AS 01.-10.070(c).

CITY/BOROUGH OF JUNEAU
ALASKA'S CAPITAL CITY

January 28, 1985

Honorable Senator Edna Armstrong-DeVries
Senate Community and Regional Affairs Committee
Pouch V
Capital Room 427
Juneau, Alaska 99801

Dear Senator Armstrong-DeVries:

The City and Borough of Juneau has noted with great interest the introduction of Senate Bill Number 48 which provides for grants to municipalities for clean air studies and air pollution abatement.

Perhaps one of the most serious health problems which exists in the Juneau area is the high level of winter-time air pollution in the Mendenhall Valley. Rising fuel prices have caused a significant and unprecedented increase in the installation and use of wood stoves. This, combined with the unique topography of the Mendenhall Valley, has caused reoccurring smoke pollution conditions which are detrimental to the health of the people of Juneau, especially young children and older persons with respiratory problems.

In October 1983, the Assembly of the City and Borough of Juneau adopted regulations which imposed restrictions on wood burning in the Mendenhall Valley. The heart of the regulations is the authority for the City Manager to declare an air emergency when air pollution levels are expected to exceed state and federal air standards. All wood burning is prohibited during an air emergency.

The current regulations place local government in the position of reacting to air pollution problems which develop rather than trying to prevent them from developing. We see a real need for a comprehensive program which will include education of people as to the proper burning techniques and research into types of devices such as catalytic combustors which can reduce the amount of wood stove emissions.

The City and Borough of Juneau would welcome the opportunity to offer testimony to the Community and Regional Affairs Committee when Senate Bill Number 48 is being discussed. Please advise us as to the time and place of the hearing.

Sincerely,

N. L. Teague
City and Borough Manager

NLT:SG:sj
cc: Senator Ferguson

CITY AND BOROUGH OF JUNEAU

MENDENHALL VALLEY AIR POLLUTION PROGRAM BUDGET

FY85-86

BUDGET ITEM		
Manpower		
	Position	Salaries
	Full-time program coordinator	$36,000
	Seasonal environmental officer	15,000
	Seasonal environmental officer	15,000
	Benefits	21,000
	TOTAL MANPOWER BUDGET	$87,000
Equipment		
	Nephalometer for measuring woodsmoke levels	$17,000
	Monitoring station	5,000
	Dicot sampler	5,000
	TOTAL EQUIPMENT	$27,000
Contractual Services		
	Wind regime study of the Mendenhall Valley to develop a model of air circulation for refined control strategy	$80,000
Public Information		
	Development and distribution of public education materials concerning wood burning and air pollution	$15,000
	TOTAL PROGRAM BUDGET	$209.000

MEMORANDUM State of Alaska

TO: Bill Ross
Commissioner
Department of Environmental Conservation

DATE: February 7, 1985

FILE NO: 366-348-85

TELEPHONE NO: 465-3600

FROM: Norman C. Gorsuch
Attorney General

SUBJECT: ADEC authority to administer clean air grants

By: Thomas M. Jahnke
Assistant Attorney General
Natural Resources-Juneau

Former Commissioner Neve' wrote us on January 31, 1985 concerning SB 48, an act making appropriations to the Department of Community and Regional Affairs for grants to municipalities for clean air studies and abatement of air pollution. the commissioner asked whether the Department of Environmental Conservation has the statutory authority to administer a program of such studies and abatement activities. The answer is a clear "yes."

AS 46.03.020 provides that the department may:

> (1) enter into contracts necessary or convenient to carry out the functions, powers, and duties of the department;
>
> * * * *
>
> (5) undertake studies, inquiries, surveys or analyses it may consider essential to the accomplishment of the purposes of the department; these activities may be carried out by the personnel of the department or in cooperation with public or private agencies, including educational, civic and research organizations, colleges, universities, institutes and foundations;
>
> (6) at reasonable times enter and inspect with the consent of the owner or occupier any property or premises to investigate either actual or suspected sources of pollution or contamination or to ascertain compliance or noncompliance with a regulation which may be promulgated under AS 46.03.020--46.03.040; information relating to secret processes or methods of manufacture discovered during investigation is confidential;
>
> (7) conduct investigations and hold hearings and compel the attendance of witnesses and the

> production of accounts, books and documents by the issuance of a subpoena;
>
> (8) advise and cooperate with municipal, regional and other local agencies and officials in the state, to carry out the purposes of this chapter;
>
> (9) act as the official agency of the state in all matters affecting the purposes of the department under federal laws now or hereafter enacted;
>
> (10) adopt regulations necessary to effectuate the purposes of this chapter, including, by way of example and not limitation, regulations providing for
>
> (A) control, prevention and abatement of air, water, or land or subsurface land pollution ...

Subsection 5 is the most pertinent, but even in its absence a court would hold that, unless specifically denied in statute, the agency has a sufficiently broad mission and attendant powers to administer the studies and abatement efforts:

> [Administrative agencies] possess the [implied] powers reasonably necessary and fairly appropriate to make effective the express powers granted to, or duties imposed on them, and to accomplish the purposes of the legislation which established them.

73 C.J.S. Public Administrative Law and Procedure, §51, p. 503 (1983).

The agency mission and statutory powers are set out in various statutes. Besides the provisions quoted above, specific grants of power to regulate air pollution are found in AS 46.03.140 et seq. The power to study air pollution is necessarily implied from the power to regulate pollution by prevention, abatement, or control. AS 46.03.140. The power to grant variances under AS 46.03.170 necessarily implies the power to undertake the investigation necessary to support the required factual findings precedent to the grant of a variance. Finally, the department has the power and duty to closely oversee local air pollution control programs, AS 46.03.210--46.03.220; the department cannot meet its responsibility without the data necessary to verify compliance with pollution standards. See, e.g., AS 46.03.210(a)(4) and (d).

For these reasons, there is no doubt that the Department of Environmental Conservation has the power to administer the research and abatement efforts.

TMJ:jf

Alaska State Legislature

Senate

Committee on Community and Regional Affairs

Official Business

Senator Edna DeVries, Chairman
Members:
Senator Ferguson, Vice Chairman
Senator Coghill
Senator Sturgulewski
Senator V. Fischer

Pouch V
Juneau, Alaska 99811

2/7/85

Summary info -- SB 48

This bill would appropriate $10 million dollars for clean air studies and abatement of air pollution.

The money could be disbursed by the Dept of Community & Regional Affairs to a named recipient that is not a municipality; the department could request proposals to provide the goods or services and if money is disbursed to other than the named recipient, the basis for taking the action must be stated in writing and a copy sent to Leg Budget and Audit; and the money may be disbursed to a non profit corporation organized by a community if there is no qualified incorporated entity. (see attached section from Title 37 of the statutes.

There is a legal opinion from Leg Counsel to Senator Ferguson that discusses the award of grant monies under this bill.

Anchorage, Fairbanks, and Juneau have submitted examples of how their money would be spent under this legislation.

Anchorage does not plan to have a witness testify, Juneau will have either Steve Gilbertson or Mr. Teague (Borough/City Manager testify). Fairbanks does not plan to have anyone testify, although their lobbyist (Linda Anderson) will be present. Anchorage person present will be Suzanne Tryck.

There is material in the file that corroborates the air pollution problems in Anchorage, Fairbanks, Juneau, Sitka, and Kenai. There is also material on Arctic Haze. The authority on arctic haze is Dr. Glen Shaw from the University of Alaska Geophysical Institute. Dr. Shaw will be present today to testify.

Arctic haze is the pollution that affects Ferguson's election district....it is the one I presume he would want money for.... it is a relatively new phenomenon -- air pollution in the other urban areas is considered to be more of an immediate problem.

Stan Hungerford from the Department of Environmental Conservation, Chief, Air and Harzardous Waste Management Section, will testify.

I called the Alaska Environmental Lobby but they said they probably would not testify.

MUNICIPALITY OF
ANCHORAGE

MEMORANDUM

TO: Senate Community and Regional Affairs Committee

FROM: Suzanne Tryck
Staff to the Municipality of Anchorage

DATE: February 20, 1985

RE: SB 48

This is the written response to the question asked during the last committee meeting on SB 48. During that meeting, Senator DeVries asked the Municipality whether any of the money in this piece of legislation would be used to study the effects of the burning of McKenzie point on Anchorage.

I have been informed that if the state does not study the effects of the burning on McKenzie point then yes, the Municipality of Anchorage will use some of the dollars appropriated to the Municipality in SB 48 for that purpose.

Thank you for your consideration of this piece of legislation. If we can be of further assistance, please let me know (586-2401).

Municipality of Anchorage

P.O. BOX 6-650
ANCHORAGE, ALASKA 99502-0650
(907) 264-4960 /Juneau 586 2401

TONY KNOWLES,
MAYOR

INTERGOVERNMENTAL AFFAIRS

February 5, 1985

MUNICIPALITY OF ANCHORAGE
SUGGESTED USES OF AIR POLLUTION FUNDS
(SB 48)

TOPIC	LOCATION	PURPOSE	EXPENDITURES	COST EST
Indoor Air Pollution Program	Statewide	To answer air quality concerns in the home. This is an area not covered by EPA, ADEC, ADOL, or US DOL.	Workshop program development Personnel Equipment Training	$ 100,000
Meteorological Tower Monitoring	Anchorage	More precise measurements of atmospheric stability to answer questions about high CO concentrations in Anchorage.	Meteorological instrumentation Telemetry equipment Tower	$ 200,000
Transit Subsidies	Anchorage	Develop the Municipality of Anchorage transit system to make it more attractive to potential riders.	Heated shelters More buses "Feeder" routes	$2,000,000
Hazardous Materials Detection	Anchorage	Develop a hazardous materials team that can react quickly to spills and protect the public. Coordinate with meteorological tower monitoring (above).	Equipment Manpower Training	$ 100,000
Carbon Monoxide Exposure Study	Anchorage Fairbanks	To determine actual exposures to carbon monoxide from indoor and outdoor sources. Determine whether outside CO measurements accurately reflect health impacts.	Monitoring equipment Manpower	$ 300,000
Acid Rain and Snow	Statewide	As a result of future in state use of coal, a baseline for acid deposition should be taken now.	Monitoring equipment Manpower	$1,000,000
Mobile Laboratory	Anchorage	To be used for air monitoring throughout the municipality.	Vehicle or trailer Air monitoring analyzer Meteorological equipment	$ 200,000
Wood Stoves	Statewide	To abate residential wood combustion pollutants.	To provide low interest loans for retrofitting or purchasing or low polluting wood stoves.	$1,500,000
Plug-in Cars (lighted)	Municipal garages	To prevent or abate cold starts.	To provide low interest loans or subsidies.	$1,000,000

Fairbanks North Star Borough

Mayor: B.B. Allen

February 1, 1985

Ms. Linda Anderson
130 Seward, #304
Juneau, Alaska 99811

Dear Linda:

Attached is a list of possible projects in the area of clean air studies and abatement of air pollution. These are the types of projects which we feel could be funded under the terms of Senate Bill 48.

Please give me a call if you have any questions.

Sincerely,

Heather

Heather T. Stockard
Environmental Services Director

HTS/mnb
Attachment

hts1-36

P.O. Box 1267 Fairbanks, Alaska 99707 (907) 452-4761

Fairbanks North Star Borough

Mayor: B.B. Allen

Suggested SB 48 Projects

Projects are listed in priority order

CLEAN AIR STUDIES

$45,000 1. Data acquisition and meteorological equipment for the Fairbanks North Star Borough. Allow for more efficient and accurate collection of ambient air quality data.

$ 70,000. 2. Non-areawide air quality monitoring in the Fairbanks North Star Borough. Use existing mobile air monitoring equipment and purchase supplemental equipment to investigate current carbon monoxide levels within the federally-designated non-attainment area. Collect evidence needed to shrink the boundaries of the designated non-attainment area.

$100,000. ← 2a. → Ice fog research

$ 75,000. → 3. Carbon monoxide exposure studies in Fairbanks and Anchorage. Determine average individual levels of exposure to carbon monoxide by residents of the non-attainment areas in Fairbanks and Anchorage.

$100,000. 4. Indoor Air Pollution -- Statewide: Determine levels of various pollutants in residences statewide. This is of special concern in super-insulated airtight houses and is an area which is not regulated by EPA, ADEC, OSHA, or municipalities.

AIR POLLUTION ABATEMENT PROJECTS

250,000 cars in FNC. & Fair. 30% will need repairs -- perhaps low interest loans 1. Vehicle Inspection/Maintenance (I/M) Program in Fairbanks and Anchorage: Provide I/M program funding to reduce or eliminate cost to individuals as a result of program implementation. Provide subsidies, grants, or low cost loans for repairs needed in order for vehicles to meet program standards.

Economic incentives -- $400,000 to $500,000 2. Wood-chipping facilities: Provide subsidies, grants, or low-cost loans to a company willing to establish a portable wood-chipping facility in the Fairbanks North Star Borough. This would allow farmers to clear their agricultural lands without violating the provisions of the proposed ADEC open burning regulations.

P.O. Box 1267 Fairbanks, Alaska 99707 (907) 452-4761

15-20,000 families affected -- Low interest loans

3. Wood Stove upgrade program -- Statewide: Provide subsidies or low-cost loans to individuals who retrofit existing wood stoves with catalytic converters or replace existing wood stoves with certified low emissions stoves.

HTS/mnb
attachment

STATE OF ALASKA
THE LEGISLATURE

LEGISLATIVE AFFAIRS AGENCY

POUCH Y STATE CAPITOL
JUNEAU ALASKA 99811
907 465 3800

MEMORANDUM January 31, 1985

SUBJECT: Senate Bill 48 Municipal and unincorporated community grants

TO: Senator Frank Ferguson

FROM: Mike F. Ford
Legislative Counsel

You have asked for an explanation of the requirements governing grants to municipalities and unincorporated communities. Specifically, grants to municipalities are governed by AS 37.05.315, which sets forth the specifics for disbursal of the grant, which is by law through the Department of Administration. Grants to unincorporated communities are controlled by AS 37.05.317, which requires the Department of Community and Regional Affairs to disburse the funds to the grant recipient. Grants to a specific named recipient, not a municipality, can be disbursed through any Department which has statutory authority to perform functions in the area for which the grant is made. This requirement is set forth in AS 37.05.316.

Regarding appropriations to named recipients, there may be more than one agency that could receive an appropriation as a grant and have the statutory authority to perform functions in the area of the grant. In some cases the statutory authority of a Department can overlap with that of another Department, in effect giving the legislature a choice of which Department to use to disburse an appropriation. For example, the Department of Commerce and Economic Development has the primary responsibility for programs in relation to economic development and planning for the state, pursuant to AS 44.33.020. However the Department of Community and Regional Affairs has general authority to advise and assist local governments, and to conduct studies and projects for developing solutions to community and regional problems pursuant to AS 44.47.050. Assuming the existence of an appropriation for community economic

development, either Department would have broad authority to disburse grant funds to a named recipient without violating statutory requirements, under AS 37.05.316.

In conclusion, SB 48 was drafted to disburse funds through the Department of Community and Regional Affairs because AS 37.05.317 requires that grant funds to unincorporated communities be disbursed by that department. Grant funds for a named recipient which is not a municipality, should be appropriated to the Department with the authority to act in the area, as required by AS 37.05.316.

MFF:ojb
J11/045

Notes taken 2/7/85 at hearing

Dr. Shaw - Arctic Haze — air pollutants that affect the upper air

Arctic haze - L.A. Smog - 2 opposite ends of a spectrum

Smog - associated w/warm air and acid rain

opposite air chemistry at the high latitude in Alaska

90% of study pertains to L.A. style pollution almost known on arctic air chemistry

Source of Arctic pollution affecting Ak is Central Eurasia (Russia)

Arctic affects - Canada - all the circumpolar nations

Symposium next year at Cambridge on Arctic Haze. Intl law aspects - State responsibility
Ak has organized and put the Sympos together put us on the map.

What has been found has application to industry

Do need to do research so that will know what industry must do in order to avoid [redacted] having

to close down some innocent industry that is Totally unaware of the harm of Arctic haze

basic vs acid -- sodium vs. vinegar
Arctic envir ~~of~~ to chemical processes that create chemical transformations

Smelter chemicals from Russia ~~—~~. to Alaska

Steve Gilbertson -- Juneau City Boro. - supports $200,000

1979 - DEC ~~set~~ monitoring wood burning pollution
Now Boro has regs against open burning -
can declare air emergency
very complex issue -
Would buy monitoring eqpt - educational mtl
Budget $200,000 could have a full time program coordinator, eqpt to measure, do a study of micro-climate of Mendenhall Valley
educa mtls - public information

Stan Hungerford - DEC
Monitoring ~~C~~ must conform to siting standards of Feds
Serve as Fed Envir Prot agent in Ak.
Stringency of data base

Control pollution in a regulatory program

Fully support concept of local area caused pollution - local agency should regulate

Difference in regs for Tesoro and North Slope refineries
Tes must remove all sulphur from oil before processing it
Mapco - distillation process - total pollutants is greater than at Tesoro - but concentration is lower.
tesoro burns cleaned-up gas

Suzanne Tryck - Mayor of Anc - supports comprehensive statewide approach

will provide info on Pt Mckenzie burning

burning at Pt Mckenzie

Fischer - level of funding to do "arctic haze research"
$300,000/yr that would result in academic research

Fischer is ice fog of — research

Ice fog -- Shaw & studied to death

Fisher well can we now do something about it

Shaw -- entrepreneurs could do something if some of this money went to them
Use the money broadly
not all to cities
not all to ice fog

~~Pt. Arktos - Murkowski - Arctic~~

$400,000 cold climate research money from Feds --
as to who gets money

Line 15 delete and

Shuld have a letter of intent

Ferguson wanted money to go to DEC - AG said I couldn't

Hungerford - AG's opinion - it can be done

OFFICE OF THE COMMISSIONER
POUCH O, JUNEAU, AK 99811

465-2666

February 2, 1984

The Honorable Jerry Ward
Representative
Alaska State Legislature
Pouch V
Juneau, AK 99811

Dear Representative Ward:

Alaska is currently in compliance with state and federal ambient air quality standards for all pollutants except carbon monoxide (CO). Since the early 1970s, CO levels in Anchorage and Fairbanks have exceeded health standards. Although airplanes, house heating units, power plants, and other industries also produce CO, motor vehicles generate 90-95% of the CO in these communities.

The Municipality of Anchorage and the Fairbanks North Star Borough have established local air pollution control agencies that have worked closely with the department to reduce public exposure to CO. Some improvements in air quality have occurred through automotive emission controls and implementation of local programs to reduce traffic congestion. However, this has been somewhat of a losing battle because both population and reliance on personal vehicles have increased, and are expected to continue to do so.

Enclosed is a brief summary of the CO violations in Anchorage and Fairbanks. Although the data on the magnitude of the violations have not been included, please be aware that Anchorage's violations are frequently more than double the national and state CO standard of 9ppm and are frequently higher than CO violations in New York City. So far, this year's high CO values are higher than last year's. Also, this winter season is the first year in which violations occured in the month of October and is the first year violations occured at a representative residential site in the month of November. From January 1 through January 23, 1984, there have been a total of 8 violations at three of the monitoring sites. This would bring the total violations for this CO season to approximately 53 for all states.

I have also included some information on the "whys" and "wherefores" of an Inspection and Maintenance program (I/M). Questions 3, 4, and 5 specifically address alternative approaches and consequences of not

implementing the I/M proram. This information was put together by the staff of Dr. Rodman Wilson, Director, Department of Health and Environmental Protection, for the Municipality of Anchorage in their efforts to correct the violations of the carbon monoxide standard. He and his staff are actively involved in all aspects of the carbon monoxide problems, transportation control programs and I/M program planning in Anchorage. I am sure he would be very willing to discuss this topic and provide additional materials needed for your sub-committee hearings. If I can be of any further help, please do not hesitate to contact me.

Sincerely,

for: Richard A. Neve'
Commissioner

RAN/DK/ne

cc: Dr. Rodman Wilson

Attachment 1

Hisotorical CO Violations

	Calendar Year	# Violations (over 9ppm) in an 8 hour period	
Anchorage			
7th and C	1975	47	
	1976	15	
	1977	14	
	1978	12	
	1979	4	
	1980	18	
	1981	2	
	1982	2	
	1983	n.o.*	
Spenard and Benson	1978	5	
	1979	63	
	1980	73	
	1981	32	
	1982	57	
	1983	49	
Garden**	1981	7	
	1982	24	
	1983	26	
Sand Lake	1980	51	(construction-traffic
	1981	6	rerouting)
	1982	6	
	1983	6	
Fairbanks			
2nd and Cushman	1975	61	
	1976	100	
	1977	105	
	1978	68	
Borough Bldg	1975	114	
	1976	118	
	1977	74	
	1978	9	
	1979	32	
SOB	1975	65	
	1976	77	
	1977	65	
	1978	49	
	1979	42	
	1980	32	

* not operational
** residential location

OFFICE OF THE COMMISSIONER
POUCH O, JUNEAU, ALASKA 99811 465-2600

January 3, 1985

Mr. Pat Teague
City Manager
City & Borough of Juneau
155 South Seward Street
Juneau, Alaska 99801

Dear Mr. Teague:

During the last woodsmoke episode it was evident that the valley residents are becoming complacent regarding burning. Numerous violators were warned and cited. Enforcement is the key to the success of reducing pollution in the Valley. Without proper and adequate enforcement we will most assuredly violate State and Federal Standards and be declared a non-attainment area by the federal government.

Four members of the ADEC staff spent 49 man-hours helping enforce the woodsmoke ban. Without this added support to the city staff, additional exceedances to the TSP standard would have been realized.

I feel a meeting is needed to discuss the ramifications of minimum enforcement and the eventual declaration of non-attainment by the federal government. Please have your Land and Resource manager, Steve Gilbertson, contact Tom Chapple of my air staff for establishment of a meeting on this subject.

Sincerely Yours,

Richard A. Neve'
Commissioner

RAN/LV/sd

OFFICE OF THE COMMISSIONER
POUCH O, JUNEAU, ALASKA 99811 465-2600

April 9, 1984

The Honorable Fran Ulmer, Mayor
City and Borough of Juneau
155 S. Seward
Juneau, AK 99801

Dear Mayor Ulmer:

I wish to express my gratitude to the City and Borough of Juneau for its positive actions to improve the air quality of the Mendenhall Valley. The joint program between city and state this past winter demonstrated that air pollution can be checked while also allowing personal firewood to be a continued component of the local energy balance.

Wood smoke in Juneau was the fastest growing air quality problem within the state. The health of approximately 10,000 people are affected to some extent during these wood smoke episodes. Unfortunately, those individuals who are least able to make their opinions and concerns known are the most readily affected. The children, the sick and the elderly are almost always the first to suffer the deleterious affects of air pollution.

As Juneau continues to grow, the city government through your direction must be prepared to respond to this and other escalating environmental problems. The recommendations presently before you and the assembly as drafted by the Air Quality Advisory Committee responsibly address these problems. It is apparent that a great deal of research, debate and forethought is encompassed in the recommendations. Each point is well founded and in unison they provide the integrated approach that is necessary to abate the problem. The establishment of an environmental health staff and the enactment of specific pollution emission standards for newly purchased stoves are the major cornerstones of an effective management program when coupled with enforcement of existing ordinances.

In summary, I urge you to adopt and implement the recommendations of your committee and I offer the resources of my staff to assist in the detailed development of each of the program components.

Sincerely,

for Richard A. Neve'
Commissioner

RAN/TC/ne

cc: N.L. Teague - City Manager
Keith Kelton
Deena Henkins

MEMORANDUM

THE CITY AND BOROUGH OF JUNEAU
CAPITAL OF ALASKA
155 SOUTH SEWARD ST. JUNEAU, ALASKA 99801

TO: N. L. Teague,
City Manager

DATE: February 24, 1984

FILE NO.

SUBJECT: Air Quality Advisory
Committee Recommendations

FROM: Air Quality Advisory Committee
Bob Jacobson, Chairman
Larry Armstrong
Dr. Dennis Batey
Mark Burger
Karleen Grummett
Verdell Jackson, Co-Chairman
Martha Kohler
Ann McFarlane
Shannon Shields
Larry Woodall
Steve Gilbertson, Staff Liason

The City and Borough of Juneau (CBJ) Air Pollution Advisory Committee has been holding monthly meetings since the enactment of the Wood Smoke Ordinance last fall. We have been getting updates from the Alaska Department of Environmental Conservation (DEC)and the CBJ staff on the effects of the ordinance and have been working with those agencies on methods of educating the public in all facets of the pollution problem. In January, the CBJ manager requested that our committee make recommendations to the Assembly regarding a moratorium on wood-burning devices in the Mendenhall Valley and on building code modifications concerning res dential heating requirements. As we have been discussing other topics during our deliberations, we have taken this opportunity to include recommendations on several other topics as well.

1. The issue of a moratorium on wood-burning devices in new residential construction was debated long and hard within our committee. Based on the feelings of an overwhelming majority of its members, our committee recommends that the Assembly enact an ordinance placing a moratorium on the installation of all wood-burning devices in new residential construction in any Wood Smoke hazard Area found within the City and Borough limits until January 1, 1985. By that date, the CBJ staff will be charged with developing emission standards and a certification program for wood-burning devices. All wood-burning heating devices sold in the CBJ or installed under conditions requiring a CBJ Building Permit from that date forth would be required to meet or exceed the standards set by the certification program. We also recommend that this program be reviewed annually because of the rapid changes in wood-burning technology. Such an ordinance can be easily enforced by building inspectors within the building permit system.

2. We find it incongruous that the current CBJ building code allows residences to be built with wood-burning devices as a major source of heat especially in the Mendenhall Valley. We, therefore, recommend that the Assembly amend this building code such that, in new

residential construction within any Wood Smoke Hazard Area contained in the CBJ limits, all heating requirements be met by other than wood-burning devices. As such, residences would be adequately heated if an extended ban on wood-burning devices was required.

3. The pollution problem, so evident in the Mendenhall Valley, can be seen to some extent throughout the entire CBJ. Open burning, in particular, has produced smoke that locally is quite obnoxious. We, therfore, recommend that the Assembly enact a limited borough-wide ban on all open burning from November 1 to March 31. This ban could be lifted on a day-by-day basis as determined by the CBJ Manager. (All open burning would, in the Wood Smoke Hazard Area, continue to be totally banned during that time.) We also recommend that the CBJ investigate and pursue the purchase and construction of a Waste-to-Energy Plant for the disposing of all solid, burnable wastes. When such a system becomes operational, we recommend all open burning in the CBJ be banned totally.

4. At the present time, there is no method by which a polluter outside of the Wood Smoke Hazard Area can be stopped. We feel that such a tool is necessary to protect those affected by careless burners. We, therefore, recommend the 50 percent opacity standard presently in place in the Wood Smoke Hazard Area be implemented throughout the CBJ.

5. As presently written, the Wood Smoke Ordinance allows people to burn newspapers and coal in wood-burning devices. This can possibly subvert the intent of the ordinance. We, therefore, recommend that Paragraph 36.40.050(a) of Ordinance 83-63 be amended changing, " . . . no person may burn wood in any manner . . ." to, " . . . no person may burn wood, wood products, or coal in any manner . . ."

6. Although no exact criteria for calling Air Emergencies was included in the Wood Smoke Ordinance, state and federal standards do give the City Manager some limits. Based on input from local U.S. Environmental Protection Agency (EPA) personnel, our committee publicly recommends that the City Manager use a 24-hour average particulate count of 150 ug/m^3 as the standard in the Wood Smoke Hazard Area. This complies not only with current EPA and DEC standards, but also with proposed EPA limits.

7. Although wood smoke is the most obvious form of pollution in Juneau and especially in the Mendenhall Valley, it is not the only one. The smoke is obvious because it can be seen and smelled. However, our committee, with input from DEC, believes that there is beginnings to be a problem with automobile emissions in the Mendenhall Valley. Conditions that are conducive to holding wood smoke near the earth's surface do the same with carbon monoxide, nitrous oxide, sulfer dioxide, and other pollutants which cars produce.

As more and more people move into the valley, this problem will become larger. It is possible that EPA standards for these emissions have already been violated in isolated instances, especially near the Mendenhall Mall.

Also, upon looking at the wood smoke episodes, we are convinced that the problem is not completely confined to the valley. It is likely that the Lemon Creek Valley will soon be subject to the same wood-burning restrictions as those in the Mendenhall Valley. Also, smoke from these sources has been drifting over the downtown area and down the Gastineau Channel.

Our committee feels that there is a critical need for a CBJ department to be charged with monitoring and dealing with all of the various environmental health concerns of the municipality. This would encompass not only air pollution but also water pollution and the various forms of waste disposal. The state is unable to adequately handle these affairs. In addition, these are City and Borough problems and the City and Borough should manage them.

As such, the CBJ Air Quality Advisory Committee recommends that the Assembly cause an Environmental Health Unit to be established with the current governmental structure. This should be done before the 1984-1985 wood smoke season.

We feel these seven proposals would tighten up the already enacted ordinance and would help make not only the Mendenhall Valley but the entire City and Borough more livable. We also feel that an Environmental Health Unit is especially important. We urge the Assembly to adopt and implement these recommendations

BJ:sj:61

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPT. OF ENVIRONMENTAL CONSERVATION

Telephone:(907) 465-2666
Address: Pouch 0
Juneau 99811

Sitka Wood Smoke
Proposed study currently under the

July 20, 1983

Mr. Rocky Gutierrez
City Manager
City & Borough of Sitka
P.O. Box 79
Sitka, Alaska 99835

Dear Mr. Gutierrez:

The Department of Environmental Conservation in conjunction with the Sitka Community High School proposes to undertake an air quality monitoring program to measure exposures of total suspended particulate matter (TSP) in Sitka.

Particulate matter can be generated from a number of sources, including windblown soils, fuel burning and industrial processes, residential wood burning and marine salt water spray. Due to the observed build-up of wood smoke pollution on a few days in Sitka last winter, the Department desires to assess the potential existence of unhealthy pollution levels.

Mr. Bill Foster of the Sitka High School has indicated an interest in performing the monitoring project. Students working directly under his supervision with initial training by Department personnel would perform the daily operational aspects of the monitoring.

During this past May, Lester Leatherberry and I assessed several potential monitoring locations in consideration of Lester's knowledge and observation of residential districts prone to smoke build-up. In establishing monitoring sites, it is imperative to select a site which will collect a sample representative of the overall air quality. For this particular type of project, it is often difficult to find a location which will not, at times, collect air parcels directly from a smoke plume emanating from a nearby house. Upon determining the residential area north and east of Swan Lake as the area of study, the small spit on the eastern shore of Swan Lake (see attached map) was found to be the only acceptable location for the sampler. This location should provide samples free of direct source impacts while also describing the overall condition of the area's air quality.

Since this site is the property of the City and Borough of Sitka, the Department requests permission to install and operate air quality and meteorological monitors for a period of two years.

A small wooden platform will be needed for the instruments. A preliminary sketch of the platform is enclosed for your review, in addition to some information on the proposed instruments. It will also be necessary to supply electrical power to the site. Although the platform has not been designed in detail, maximum considerations will be made to ensure the platform and equipment are compatible with existing site usage. The ground surface at the site will be disturbed only for the location of four cement footings and possibly to bury electrical cable from a nearby powerline.

If approval is granted, we would desire to begin equipment installation during September of this year. Should you desire some additional clarification on this request, please contact me.

Sincerely,

Tom Chapple
Air Quality Engineer

Enclosures

cc: Lester Leatherberry - Sitka DO
Deena Henkins - SERO
Bill Foster - Sitka High School
Tom Trible - Lab

Thomas R. Hanna
Section Chief
Air and Solid Waste Management

March 28, 1980

Stanley W. Hungerford
Environmental Engineer IV

Public Hearing
Tesoro Variance Request

On March 19, 1980 I held a public hearing at the Kenai Borough Building in Soldotna to receive testimony on Tesoro Alaska Petroleum's request for a variance from emission regulations and/or the circumvention regulation for sulfur dioxide emissions from a proposed sulfur recovery plant. Ten persons attended the hearing, two Tesoro representatives testified, and one individual asked a number of questions and expressed concerns about the cumulative effects of continued industrial growth. We also received written comments from two persons and two others requested copies of the variance application and other information.

Mr. Grantham, Tesoro project engineer, described the sulfur plant project, its relationship to the already permitted refinery modifications, and the company's efforts to find a vendor that might guarantee compliance with existing State emission standards without the use of dilution air. He also discussed the estimated change in air quality due to the sulfur dioxide emissions, and presented some general information from studies of sulfur dioxide impacts on human health, conifers and laboratory animals.

Mr. Jakubas commented that he didn't particularly object to the SO_2 emissions so long as they weren't offensive. However, he did express considerable concern for the increasing amount of NOx emissions in the Kenai area, and the possible acidification of poorly buffered lakes. from acid rain and/or dry (nitrate) deposition. He also had a number of questions about the BACT alternatives presented in the PSD application, seasonal variations in meteorology and seasonal changes in patterns of "areas of influence" to which Mr. Grantham responded.

Mr. Pat Thomas, Tesoro's legal representative, briefly discussed socio-economic aspects of the project -- less air pollution due to the increase in un-leaded gasoline production, more petroleum products available for use in Alaska enhancing the economy, and the temporary increase in construction jobs available to Kenai residents.

Mr. Charles F. Bailey, Assistant Trust Officer of National Bank of Alaska in Anchorage, in written comments, expressed concern that objectionable odors might be evident on the property held in trust, and if such were the case, his client had instructed him to enter an objection to the request for a variance.

Mr. James E. Frates, Refuge Manager of the Kenai National Moose Range, submitted a lengthy list of concerns and questions many of which related to acid rain etc. A number of his questions pertained to the PSD review. Two questions were about the reason for the State's regulations and one about field surveillance activities.

Based on my review of the Variance application and testimony submitted. I have concluded that we should amend the permit and grant a variance to Tesoro which allows them to operate the H_2S incinerator and dilute the exhaust to comply with the SO_2 emission limitation.

02-0018 Rev. 10-76

STATE
of ALASKA

MEMORANDUM

TO: Stanley W. Hungerford
Environmental Engineer IV

DATE: April 2, 1980

FILE NO:

TELEPHONE NO:

FROM: T.C. Trible T.C.T
Chief, EQM&LO

SUBJECT: Tesoro-Alaska Kenai Refinery; Suggestions for Monitoring

I have reviewed Mr. Frates' letter regarding the Tesoro-Alaska Kenai refinery. The following are my suggestions and comments.

Generally speaking, the many concerns expressed by Mr. Frates represent hypothetical situations rather than actual or anticipated conditions. There is no point in my trying to address Mr. Frates' concerns individually since I presume that you will be doing that in your letter.

However, there are some actions that we can take in order to provide you with factual information regarding environmental conditions.

We can develop an ambient air monitoring strategy for the area of concern considering siting requirements, instrument selection and performance testing, calibration, maintenance and data reduction. District office personnel must operate the equipment, however. We might want to establish SO2, O3, Oxides of Nitrogen and TSP sites at one or two locations.

We can develop a program for monitoring water quality of nearby lakes and streams evaluating parameters such as TKN, NO3-NO2, sulfate, pH, carbonate alkalinity and perhaps even hydrocarbons. Again district office support would be required to collect samples and measure pH as well as carbonate alkalinity. EQM&LO can provide the required laboratory support.

In order for you to decide how far you wish to go with this problem, I have included in the following an estimate of new equipment costs.

I AMBIENT AIR MONITORING

A Sulfur Dioxide

1.	TECO Model 43 SO2 analyzer	8,500
2.	METRONICS Dynacalibrator	5,350
3.	SUPERSCRIBE strip chart recorder	1,600
4.	MONITOR LABS signal averager	1,100
5.	Miscellaneous commodities	250
		16,800 per site

B Ozone

1.	DASIBI Model 1003-RS Ozone analyzer	5,750
2.	SUPERSCRIBE strip chart recorder	1,600
3.	MONITOR LABS signal averager	1,100
4.	Miscellaneous commodities	250
		8,700 per site

C Oxides of Nitrogen

1.	MONITOR LABS Model 844-E NO(X) analyzer	10,000
2.	CSI Gas phase titration calibrator	9,000
3.	SUPERSCRIBE strip chart recorder	1,600
4.	MONITOR LABS signal averager	1,100
5.	Miscellaneous commodities	250
		21,950 per site

Total equipment costs per site for ambient air monitoring are $47,450. I recommend a back-up strip chart recorder and signal averager for an additional $2,700 and a total of $50,150.

II WATER QUALITY MONITORING

A Non-conservative Parameters

1. ORION pH meter, probe and buffer solutions, alkalinity gear 950

B Conservative Parameters

1. All required water chemist y can be incorporated into the existing program.

I have included one of these sites in our request for additional ambient air monitoring equipment. Please advise me how you want to go with this problem.

I A-5c

Tom Trible
Chief, EQM & LO

April 9, 1980

Stanley W. Hungerford
Environmental Engineer IV

Kenai Air/Water
Monitoring Program

Tom, your suggestions for a multi-parameter monitoring program for obtaining "backgroumd" air and water quality data in the Kenai area looks good to me. Please obtain the equipment (via Tom Hanna's grant funds) and arrange to set up a monitoring station somewhere in the vicinity of the Collier-Phillips-Tesoro industrial complex about 10 miles north of Kenai. Enclosed is a map from Tesoro's PSD application which indicates calculated pollutant concentrations in the area, and another map showing locations of major facilities.

I hope you can get the program started while I am on leave, but if not, we should get together as soon as I return. Here are the names of company officials who might be able to help you site the instruments and obtain power:

Union Chemicals --

Mr. George Ford, Plant Manager (776-8121)
Mr. Bill Switzer, Environment Engineer

Phillips Petroleum --

Mr. J. F. Settle (776-8166)

Tesoro Alaska Refining --

Mr. Mark Necessary (776-8191)
Mr. Ray Measles, Laboratory Supervisor

Chevron USA (refinery) --

Mr. George E. Day, Manager (776-8161)

Chugach Electric Ass'n --

Mr. L. J. Schultz, General Manager (276-3500)
Mr. Larry Marley, Manager, Environmental

Summary Information
Alaska Arctic Air Pollution Planning Symposium

The purpose of the symposium is to assemble experts from a wide variety of disciplines to discuss the issues and ramifications of Arctic air pollution and to lay the ground work for a follow-up international meeting.

This symposium is convened by the University of Alaska and funded by the State Legislature at the request of the Honorable F. R. Ferguson, Alaska State Senator.

A major objective of the meetings is to determine, at the request of Senator Ferguson's office, whether growing air pollution in the remote Arctic regions constitutes any threat to health or environment and, if so, to assess the situation and make recommendations for a plan of action.

Arctic air pollution is a phenomenon which has come to the attention of scientists only recently. The pollution affects large portions of the northern polar cap of the planet; it is remarkable because of its aerial extent.

After a decade of research, mainly in the North American and Scandinavian Arctic, we have learned that the "Arctic Haze" is the results of industrial air pollution. In Alaska the haze pollution is thickest on the North Slope of the Brook's Range and extends eastward at least to Norway, or roughly half way around the circumference of the Arctic, and probably further. The pollutants sometimes extend up to 18,000 feet, but usually are contained in layers close to the ground. In late winter months the pollution can become quite dense.

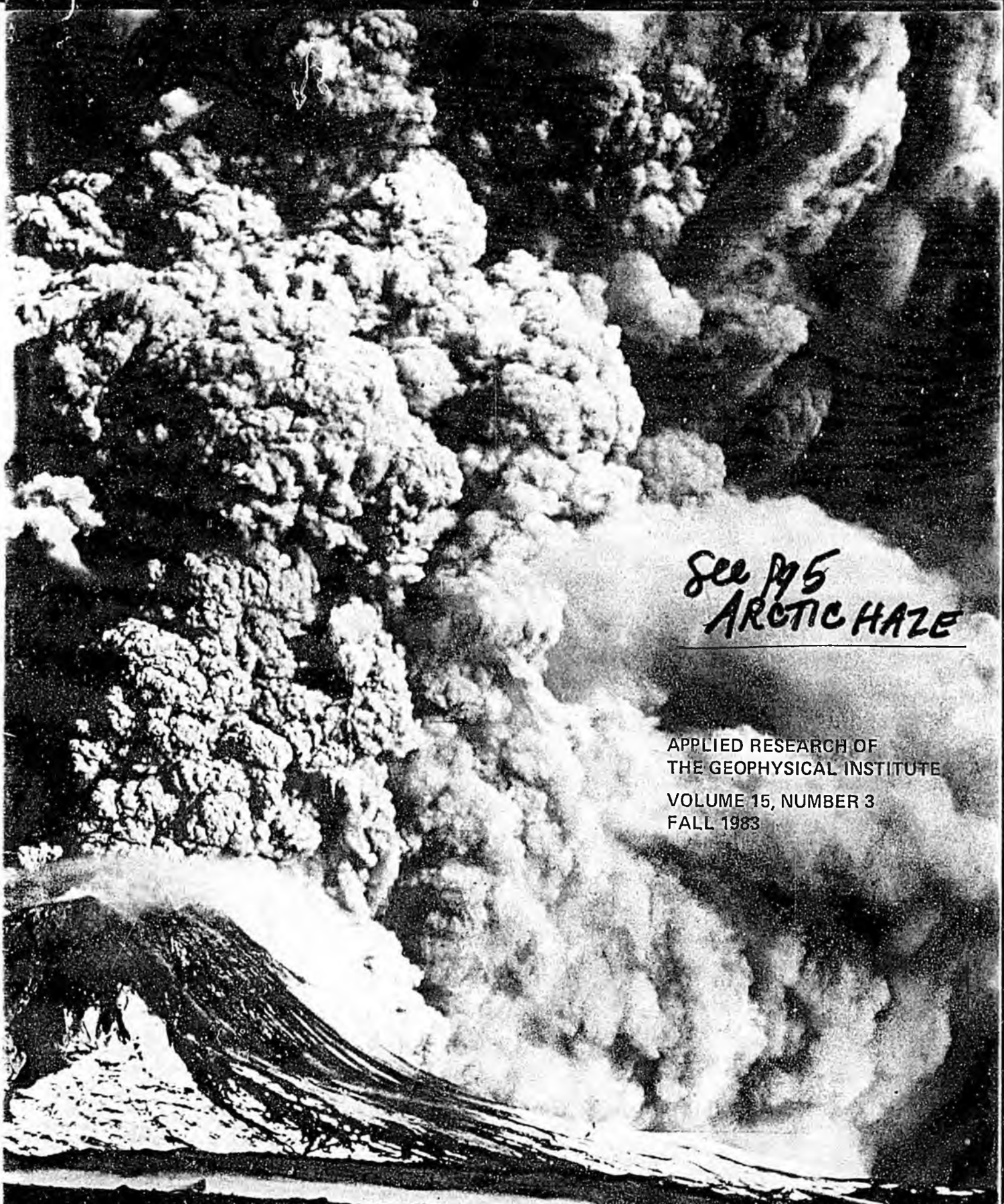
A research group at the University of Rhode Island (under the directorship of Kenneth Rahn) has developed a system of chemical tracers that can reveal where a given sample of polluted Arctic air comes from. The work has shown quite clearly that the major source of pollutants in the American Arctic is the Soviet Union. After the USSR, Europe and, we think, the United Kingdom are the next largest sources. Nroth America contributes very little pollution to the Arctic, primarily because of air flow patterns and location.

In 1983, instrumented aircraft from the United States, Norway and the Federal Republic of Germany flew into the high Arctic and sampled the air; pollution by-products were found in higher than expected concentration and all the way to the North Pole.

Arctic air pollution is sampled at Geophysical Institute's field stations in central Alaska and at a U.S. Department of Commerce station near Barrow. When air is drawn through white filters, the filters sometimes turn dark gray in color. According to Hal Rosen at the Livermore Laboratory in California, the discoloration is caused by carbon particles. Scientists are concerned that the black light-absorbing carbon particles over the reflecting polar ice might disturb the climate.

It is believed that a dialogue between health experts, government and industrial representatives, and scientists in symposia like these may help set the stage for a rational future policy.

Glenn Shaw
Geophysical Institute
University of Alaska



See p. 5
ARCTIC HAZE

APPLIED RESEARCH OF
THE GEOPHYSICAL INSTITUTE

VOLUME 15, NUMBER 3
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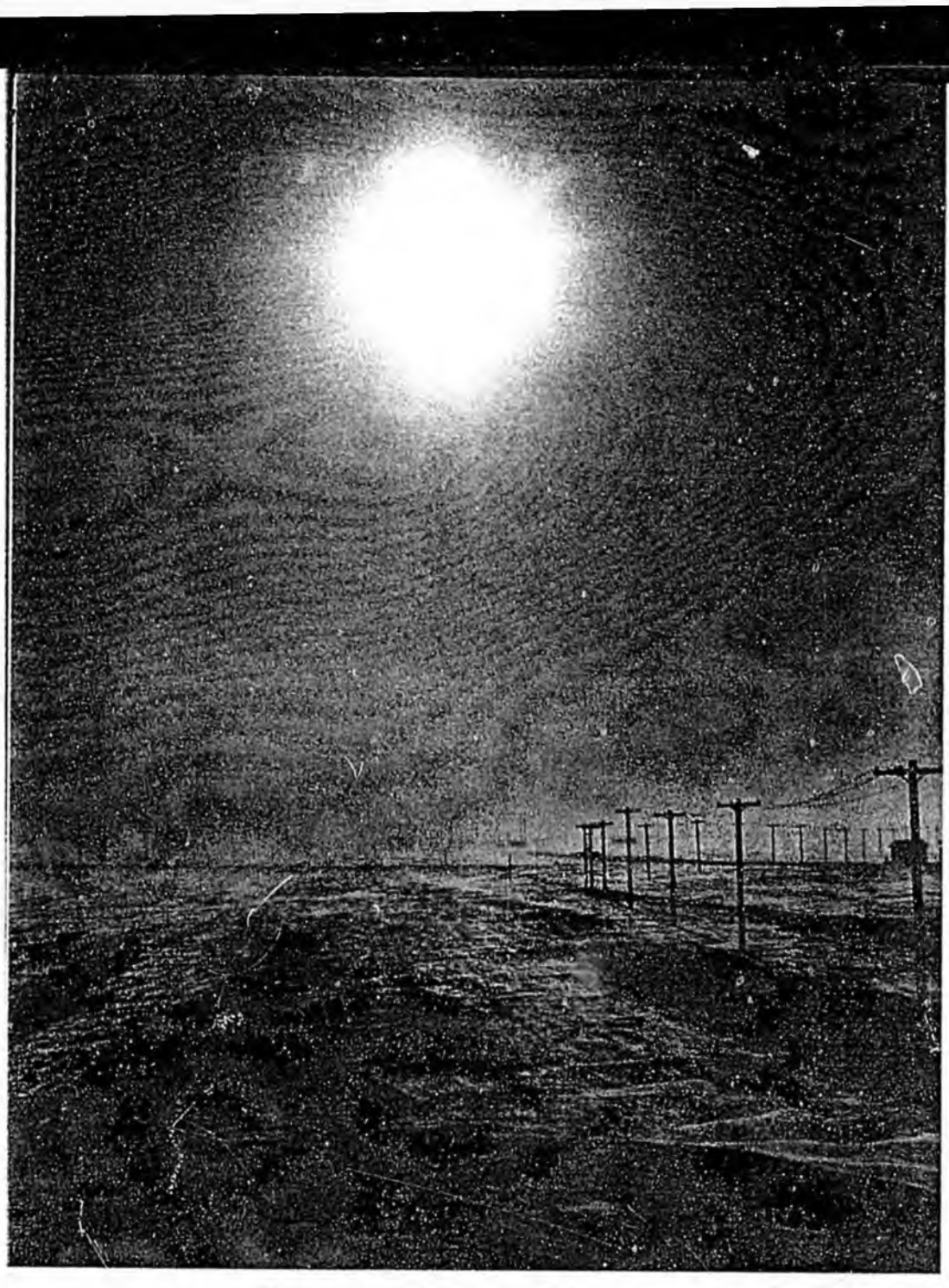
applied science & technology in the north

THE NORTHERN ENGINEER



ARCTIC HAZE

by Glenn E. Shaw

Figure 1. Arctic haze as photographed near Barrow, Alaska, in April, 1978.

INTRODUCTION

The great clarity of polar air is legendary; polar explorers have frequently commented on it. Indeed, it should come as no surprise that polar air is frequently clear; there is no dust, there is no local air pollution to speak of, and the polar oceans and land masses are covered with ice and snow most of the time.

Nevertheless, something started going awry, apparently around the end of World War II. People began reporting the existence of haze at high-latitude locations in the Scandinavian and Alaskan Arctic. At first it was believed, as was often in fact the case, that the observers were reporting visibility reductions caused by blowing snow or precipitations of ice crystals. But

Dr. Glenn E. Shaw *is a professor of geophysics at the Geophysical Institute, University of Alaska, Fairbanks. He has been studying the arctic haze phenomenon since the mid-1970s and has published numerous articles on the subject.*

in 1956 J.M. Mitchell, who was then a young weather officer stationed in Alaska (and now is a noted climatologist), flew on a B-29 USAF "Ptarmigan" weather reconnaissance flight and took a close look at the haze which was being reported by the pilots. Mitchell had a good eye for detail and he surmised from the color and the way it scattered light that the haze was composed of submicron-sized particles; there was no way that ice crystals or blowing snow could cause such effects. Mitchell published his interesting observations, but his paper apparently attracted little attention and was soon buried in the literature and forgotten.[1]

In the early 1970s turbidity at several arctic stations was found to be higher than expected and to have a seasonal variation opposite to that at midlatitudes.[2,3] (Turbidity as used here refers to the haziness of the atmosphere, and is usually expressed in terms of how much sunlight is lost on its way through the atmosphere when no clouds are present.) This finding was entirely unexpected and puzzling. Subsequent investigations from 1973-1977 confirmed that the haze was strongest in late winter/early spring (Fig. 1).

Investigations were made with a research aircraft at Barrow to try to learn more about the haze. These showed that the haze concentration usually increased from the surface and reached maximum concentrations at several thousand meters altitude (Fig. 2). From this, we deduced that the haze is not produced from nearby surface sources. The altitude of the haze, its horizontal extent covering hundreds of kilometers, and its association with air masses coming from the north have made it difficult to understand exactly where the haze originates. All that could be said at the time of the early studies was that the particles had been carried in from very distant sources. The source of the haze itself remained a puzzle.

In 1976 studies of arctic haze were intensified. A series of chemical sampling experiments, carried out by Kenneth Rahn and Randolph Borys at the University of Rhode Island, were aimed at determining the composition of arctic haze. The results were quite surprising. They told us that arctic haze is rich in elements associated with industrial pollution, such as vanadium (V) and manganese (Mn). This was the first of several indications we now have that arctic haze is not natural in origin but is associated with industrial air pollution.

THE SUMMER-WINTER CONTRAST

The presence of haze in the arctic atmosphere during winter is as surprising as its absence in the summer. Why is the seasonal variation opposite from that found at the midlatitudes?

At most places the strongest pollution concentrations occur during summer. Near arctic coastal regions in summer, one can imagine a suite of local particle sources: organic vapors, combustion products from wildfires, windblown material from loess deposits, and salty particles blown from the arctic seas, among others. These sources disappear in the winter and, in addition, air convection currents also disappear or are much weaker in winter. That is why it is so surprising to find a decrease, rather than an increase, in haziness as winter changes to summer in the Arctic.

The winter-summer contrast is apparently Arctic-wide; we've found that sampled particles from the air at Thule, Greenland, at Spitsbergen, and near Fairbanks (representative of interior Alaska), all show pronounced winter maxima. In general, one can say that arctic air is clean in summer, but dirty in winter.

Generally the haziness is small in the autumn months but starts building in late

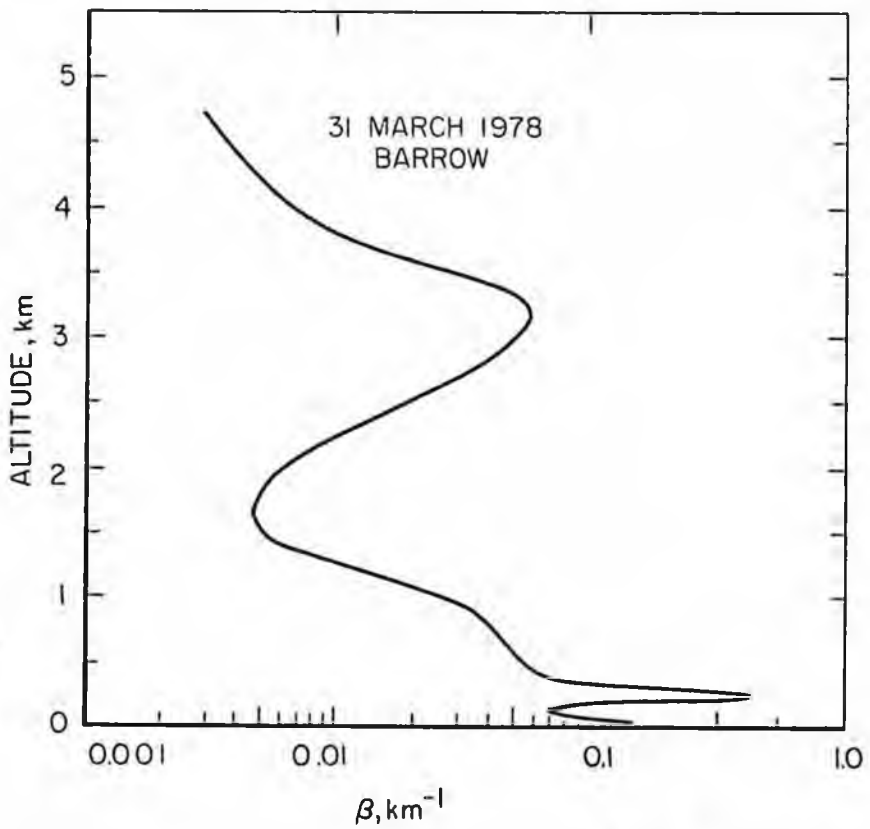


Figure 2. Vertical profile of arctic haze over northern Alaska, representing the profile of optical extinction; it is more or less proportional to the particle mass concentration.

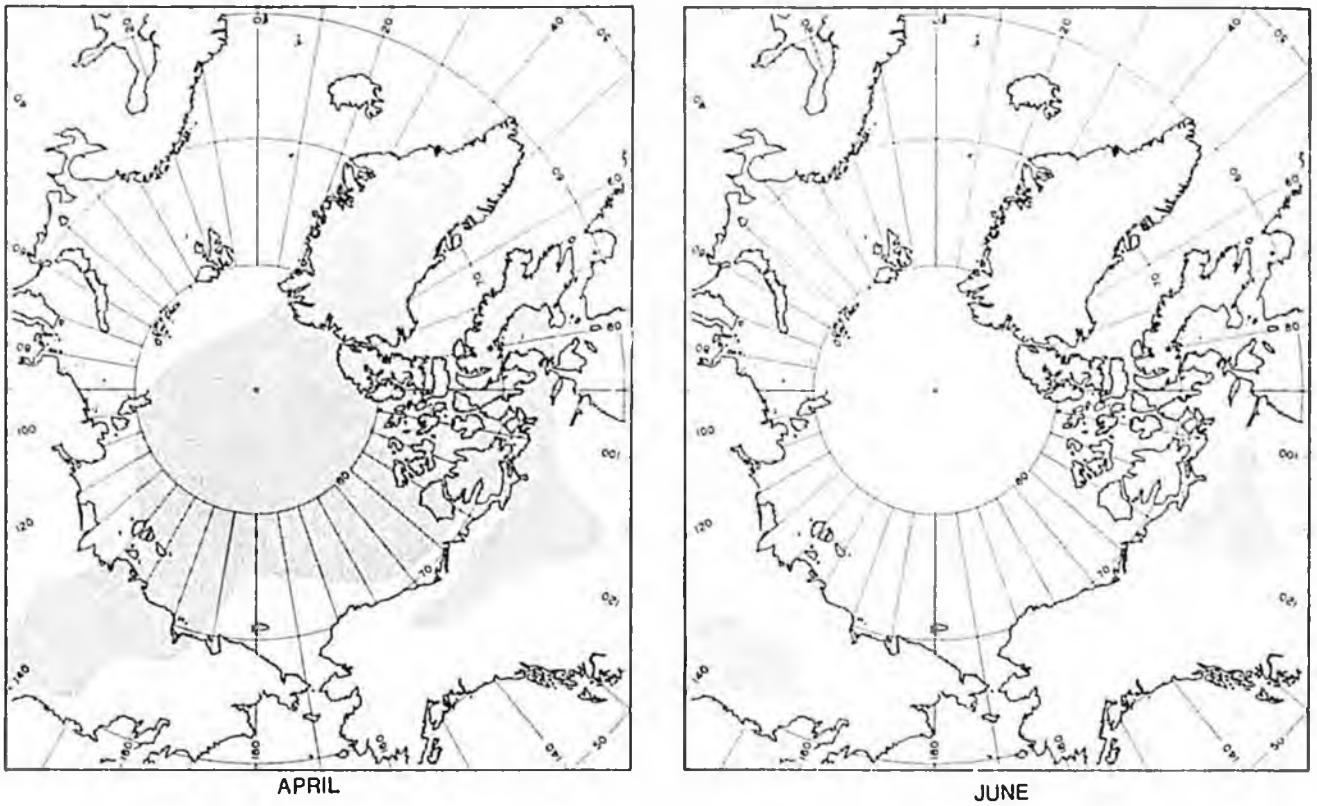


Figure 3. The arctic haze disappears in the late spring, with the onset of extensive cloudiness. Shaded areas are cloud-free.

November and December, reaching a maximum in March-April; after that, the haze virtually disappears. The disappearance of the haze in late spring is associated with the onset of extensive cloudiness in the Arctic (Fig. 3). Apparently the water droplets in the stratus clouds filter out the haze and clear the air.

The arctic air remains very clear all summer, except for occasional inflows of smoke from wild fires burning in the tundra or in the high-latitude forests. In any case, the chemical pollution indication disappears in summer; all we find are occasional bursts of naturally occurring substances, such as wind-blown dust, sea salt particles, or forest fire smoke particles.

In late winter the situation is very different: the entire arctic basin is then filled with pollution-derived substances.

POLLUTION COMPONENT OF THE ARCTIC WINTER AEROSOL

The conclusion that arctic haze is mainly pollution-derived can be supported by studies of individual strong haze episodes that occur during winter in relation to the meteorological situation that preceeded the haze buildup. In this way, Wolfgang Raatz identified the major pollution transport pathways to the Alaskan Arctic. Raatz, working on his Ph.D. dissertation, found that the most important source region for arctic haze in Alaska is the general geographic area of Eurasia (Fig. 4).[4] North American sources contribute only in minor ways to the Alaskan-sector air pollution problem. Some of the major transport pathways of pollution by-products to the Alaskan Arctic are illustrated schematically in Figure 5.

The strongest indication that arctic haze is pollution-derived comes from the high concentrations of pollution-associated elements, such as vanadium. A useful way of expressing the relative increase in concentration enrichment (or for that matter depletion) of an element is to compare its concentration with that normally found in the earth's crust. The strong enhancements seen in vanadium and manganese in the winter months imply that arctic haze consists of particles from industrial pollution.

Another indicator of pollution is the gray coloration of winter filter samples. The color comes from the presence of

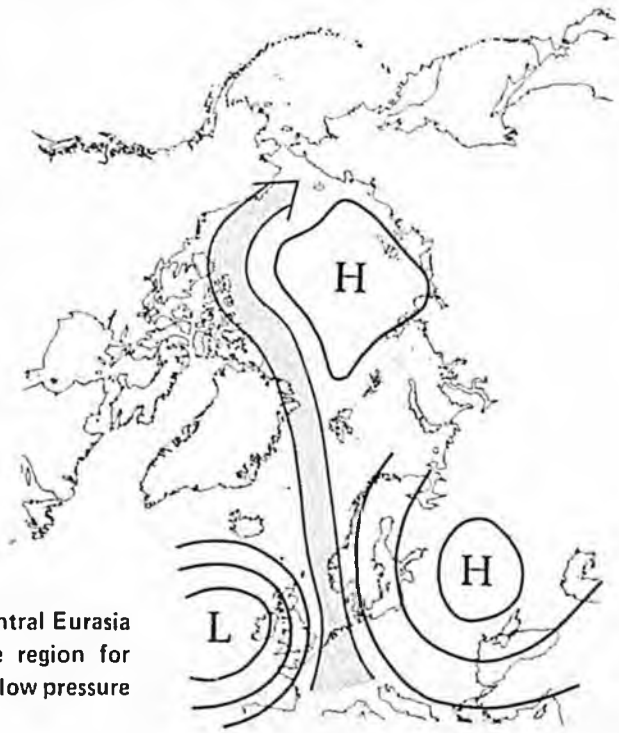


Figure 4. Map showing that central Eurasia is the most important source region for Alaska's arctic haze.[4] High and low pressure areas are indicated.

sooty, unburned carbon, an element likely to have originated from man-made combustion processes. Perhaps the most convincing evidence for a man-made source of the haze is the high concentrations of sulfate in the haze that always occur simultaneously with the pollution tracers. Sulfate accounts for more than one-half of the mass of atmospheric particles over Barrow (Fig. 6). By considering the transport and evolution of sulfate aerosol, Rahn and McCaffrey have found that the majority of it is likely to come from conversion of gaseous sulfur dioxide to particles.[5] The major source of this is SO_2 is from midlatitude pollution!

WHY IS THE ARCTIC POLLUTED?

The concentration of haze and gases such as sulfur dioxide in the Antarctic is about a tenth of that found in the Arctic. This is not surprising if the hypothesis is true that arctic haze comes from industrial activity, for 90 percent of the world's industrialization is concentrated in the northern hemisphere. Strong convective storms in the Intertropical Convergence Zone near the equator prevent most northern pollutants from passing into the southern hemisphere.

The arctic regions in general, and especially the Alaskan Arctic regions, are distant from air pollution sources. Within the northern hemisphere the atmospheric circulation patterns that transport pollutants north-south are less efficient in summer than in winter. In summer the east-west airflow effectively cuts off the arctic regions from the lower latitudes; this is a major reason for the low summer pollution at places such as Barrow. In summer the arctic air is almost as clean as the antarctic air. In winter, as we have mentioned, the arctic atmosphere becomes dirty.

There are three reasons why arctic haze is most pronounced in winter: (1) increased winter emissions of pollutants, (2) more rapid and efficient poleward transport by meteorological systems in winter, and (3) longer residence times of the haze particles in the atmosphere. The third reason is based on the fact that clouds and precipitation are quite efficient at removing ("scavenging") pollution particles from the atmosphere, and both clouds and precipitation are less prevalent in the Arctic during winter than they are in summer (Fig. 3).

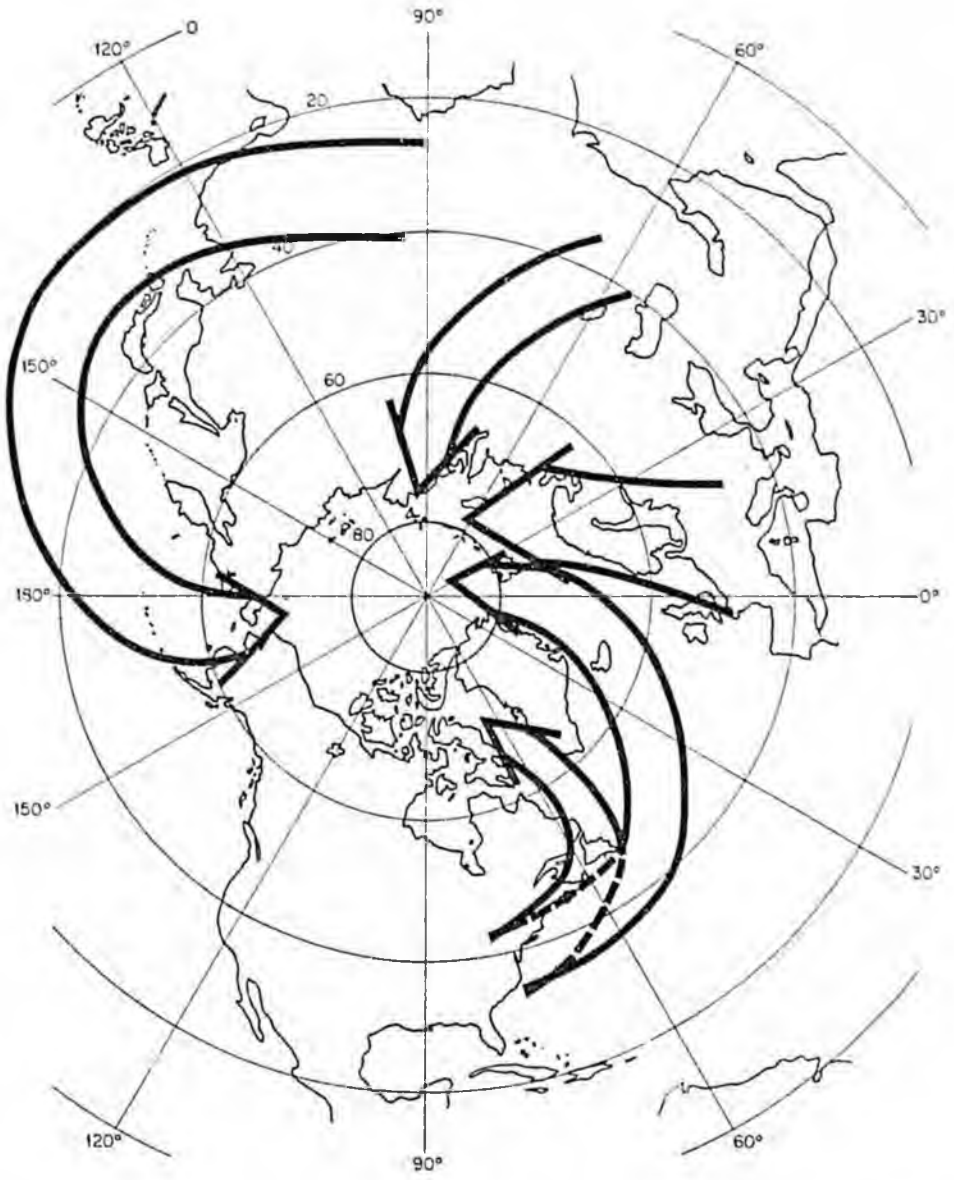


Figure 5. A schematic presentation of the major pathways of industrial pollution into the Arctic.

It also probably is true that particle removal rates decline substantially in winter due to the high convective stability of arctic air. Arctic air is analogous to the stable cold air which sinks down to the bottom of a deep-freeze chest. Because stability limits the strength and number of turbulent eddies, it takes longer for particles to be removed by being carried close to and catching on or diffusing onto the surface.

RESEARCH ON THE SOURCES OF ARCTIC HAZE

Efforts are being made to trace the origins and pathways of arctic haze and to pin down the source regions in more detail. By observation alone, it is easy to eliminate eastern Asia as a major source of Arctic aerosol: the air from the Pacific pathway is the cleanest observed, because of the extensive storminess along the route. Likely source regions were early on suspected to be eastern North America and Europe, including the western USSR.

Raatz[4] analyzed synoptic weather patterns occurring during and before episodes of arctic haze at Barrow. By using an iterative "closure" approach, he was able to demonstrate that most strong episodes of haze in the Alaskan Arctic are preceeded by surges of northward-flowing air over polluted areas in eastern North America, Europe and the Soviet Union. The pollution-laden air travels in characteristic large-scale anticyclonic air circulation patterns.

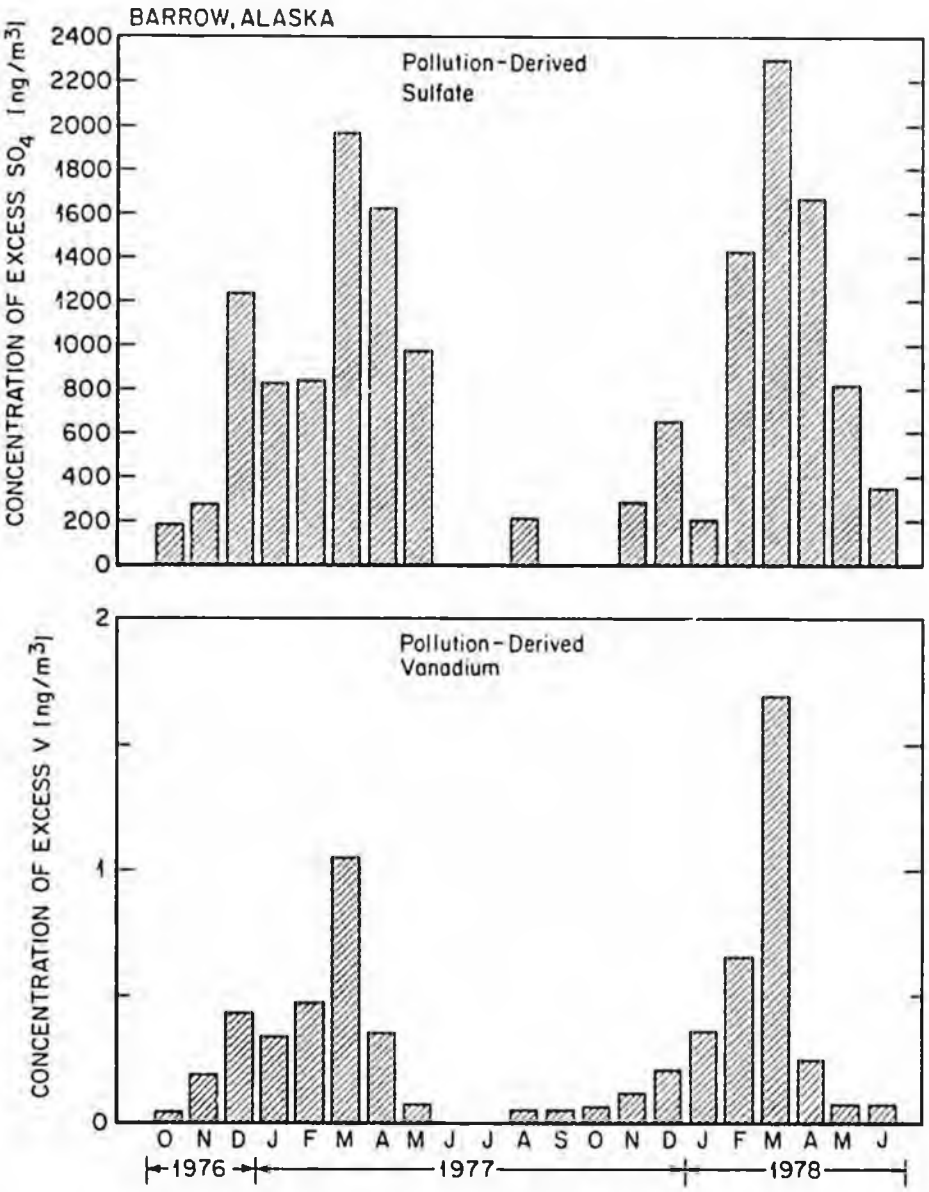


Figure 6. Seasonal variation of pollution-derived sulfate and vanadium, Barrow, Alaska.

Rahn,[6,7] on the other hand, investigated the use of chemical signatures in air samples collected in the Arctic. Characteristic signatures of certain trace elements present in the aerosol component of arctic haze seem to relate to specific, albeit large, geographical regions in which the pollution aerosol was injected initially into the atmosphere. An example is the ratio of "non-crustal" manganese to vanadium which varies for source regions in the eastern U.S., in Europe, Eastern Europe and the Soviet Union. Part of the reason for the variation pertains to the abundances of elements present in fuels. Another factor may be sociological in nature, reflecting the variations in the air pollution controls in the different countries, the relative ratio of coal to oil burned, the number of automobiles, etc. The central region of the Soviet Union, for instance, is a coal-based society with a heavy steel-processing industry and, apparently, considerable air pollution.[8] The region is a heavy producer, relatively speaking, of submicron particles containing Mn, whereas V is a common submicron aerosol found in effluents from industrial sources burning fuel oils. Since the United States is an oil-based society, the Mn/V ratio is larger in pollution by-products from the Soviet Union than it is from the United States. The example shows the principle on which characteristic chemical patterns can be used to deduce relative strengths and source regions of pollution flowing to the Arctic.

From analytical models of the transport of material from midlatitudes to the Arctic, it has been learned that arctic haze particles are mainly secondary products, having been formed from the conversion of trace gases, especially by the oxidation of sulfur gases.[5] The models indicate that the transit time to the Arctic is about 10 days. Thus it appears that arctic haze is caused by particles and gases injected from the lower latitudes. Both Rahn and Raatz deduced that central Eurasia is the primary source region for arctic haze in Alaska during midwinter, whereas European sources become more predominant in spring. North American sources are fairly minor, contributing perhaps one-fifth of the arctic haze in Alaska.[7]

SIGNIFICANCE OF AIR POLLUTION AEROSOL IN THE ARCTIC

The average size of particles making up arctic haze is around half a micrometer, a size comparable to the wavelength of visible light (Fig. 7). Particles such as these interact strongly with sunlight and redistribute the radiation fluxes in the atmosphere and at the surface. In addition, radiative interactions occur between the particles and the infrared terrestrial (heat) radiative fluxes in winter, when the sun is down. What, if any, effect does the redistribution of radiant energy have on climate? Unfortunately a complete answer is not yet available.

Preliminary calculations indicate that in springtime the haze introduces slight cooling at the surface and a relatively strong heating within the haze layer itself. In winter, the haze would warm the lower layers of the atmosphere and the surface.[9] The response of weather, and ultimately climate, to such forced cooling and heating is difficult to predict because of complicating positive and negative feedback mechanisms. For example, the cooling near the surface and the heating aloft alters the dynamic stability of the atmosphere and introduces air subsidence which could affect cloudiness. The haze may also affect the nucleation properties of the arctic atmosphere and through this mechanism change cloudiness and precipitation. Very little is known about the extent of these effects.

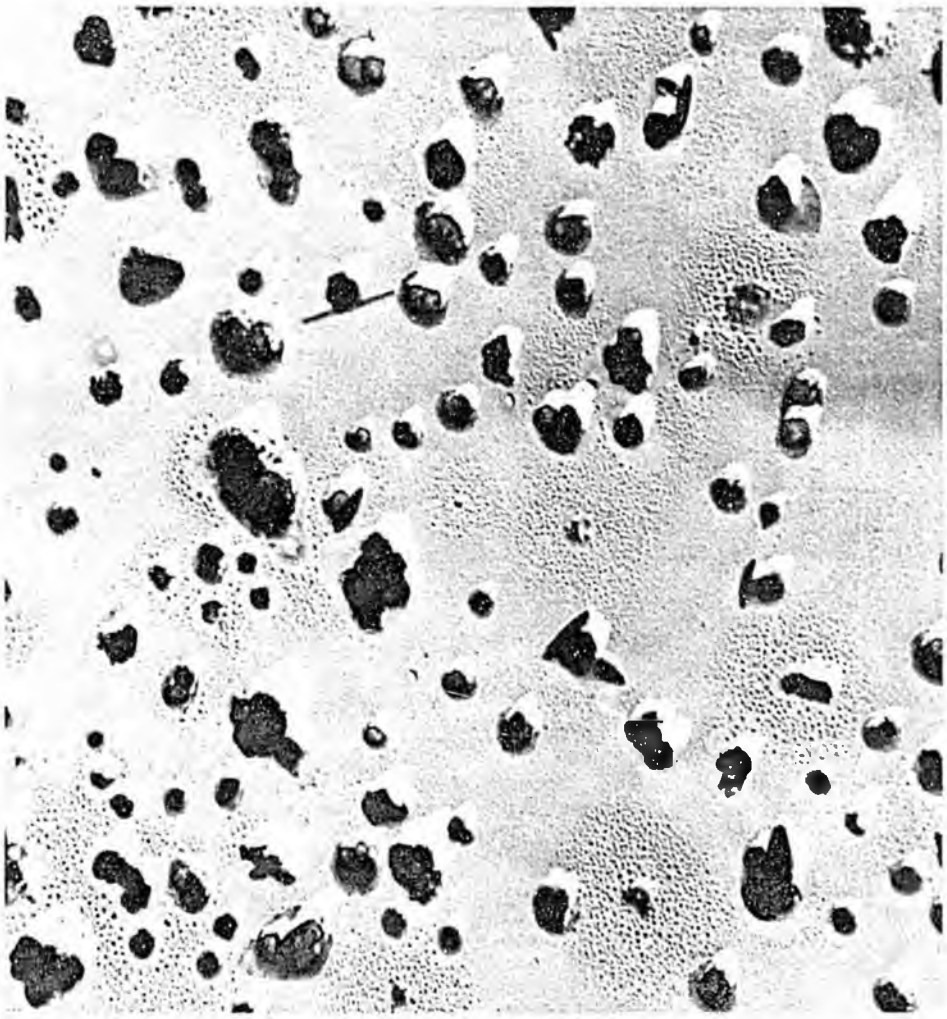


Figure 7. Electron microscope photograph of arctic haze particles collected at Barrow, Alaska. Most of the particles contain sulfur. They have been overcoated with a thin layer of barium monoxide so they can be photographed more clearly; the electron beam illuminating the sample casts slant shadows. (Photograph courtesy of Dr. E.K. Bigg.)

Arctic haze particles will deposit on the surface, though in relatively low concentrations, and the environmental consequences of deposited acidity, sulfate, nitrate, heavy metals and organic substances on the pack ice and tundra are not yet known.

The most significant result of studies of arctic haze is the recognition that huge areas of the world are being affected by pollution aerosols and gases. On a monthly basis, the Arctic and Euro-Asian subarctic are all nearly equally polluted by sulfate aerosol, at least in winter. Clearly arctic haze is a multinational, even a multicontinental phenomenon. Future research should clarify many questions about arctic haze that are presently unanswered.

ACKNOWLEDGMENTS

The research on arctic haze has been supported by the Office of Naval Research under contract N-00014-C-0435 and the National Science Foundation under grant DPP77-27242. Facilities of the Naval Arctic Research Laboratory, Barrow, were used in the studies (Fig.8).

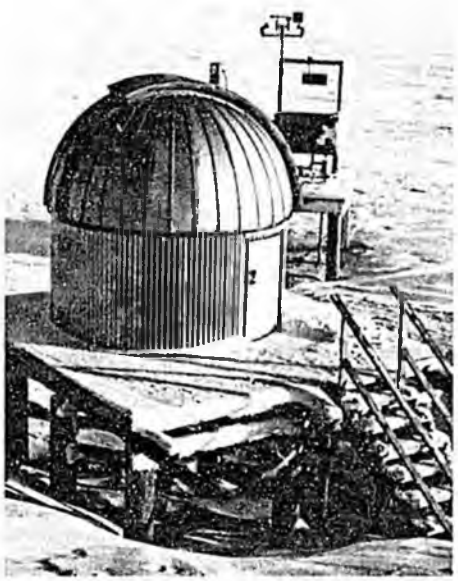
REFERENCES

[1] Mitchell, J.M., Jr. 1956. Visual range in the polar regions with particular reference to the Alaskan Arctic. *J. Atmos. Terr. Phys.* (Supplement), pp. 195-211.

[2] Shaw, G.E., and G. Wendler. 1972. Atmospheric turbidity measurements at McCall Glacier in northern Alaska. Proceedings of the Atmospheric Radiation Conference, Ft. Collins, CO, August 7-9.

[3] Holmgren, Bjorn. 1971. Climate and Energy Exchange on a Sub-Polar Ice Cap in Summer, Part E, Radiation. Climate Meteorologiska Institutionen, Uppsala Universitet.

[4] Raatz, W. 1983. Arctic Haze: Meteorological aspects of long-range transport. Ph.D. Dissertation, University of Alaska, Fairbanks, AK.



igure 8. Typical observation station at Barrow (operated by U.S. Dept. of Commerce).

[5] Rahn, K.A., and R.J. McCaffrey. 1979. On the Origin and Transport of the Winter Arctic Aerosol. Paper presented at the Conference on Aerosols: Anthropogenic and Natural—Sources and Transport. New York Academy of Science, January 9-12.

[6] Rahn, K.A. 1981. The Mn/V ratio as a tracer of large-scale sources of pollution aerosol for the Arctic. *Atmos. Env.* 15: 1457.

[7] Rahn, K.A. 1981. Relative importance of North America and Eurasia as sources of Arctic aerosol. *Atmos. Env.* 15:1447.

[8] Komarov, B. 1980. The destruction of nature in the Soviet Union. M.E. Sharpe, Inc., White Plains, NY.

[9] Shaw, G.E., and K. Stamnes. 1980. Arctic Haze: Perturbation of the polar radiation budget. *Annals of the New York Academy of Science* 338:533-539. ♦

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November 1983

EPA

Carbon Monoxide Study Anchorage, Alaska

November 22, 1982
to
February 11, 1983

ANCHORAGE

CARBON MONOXIDE STUDY

November 22, 1982 - February 11, 1983

Prepared by

Jon W. Schweiss
U.S. Environmental Protection Agency, Region 10

With The Cooperation and Concurrence

of

George LaMore
Anchorage Air Pollution Control Authority

Thomas Chapple
Alaska Department of Environmental Conservation

DISCLAIMER

This report has undergone the U. S. Environmental Protection Agency's (EPA) peer review process and has been reviewed by both the Anchorage Air Pollution Control Authority/Municipality of Anchorage (AAPCA/MOA) and the Alaska Department of Environmental Conservation (ADEC) and is approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the EPA, AAPCA/MOA, or ADEC, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

PREFACE

As prescribed in the Clean Air Act (CAA) of 1970, the U.S. EPA established National Ambient Air Quality Standards (NAAQS) for protection of the public's health from carbon monoxide in air external to buildings to which the public has access. In a number of cities nationwide, including Anchorage, these standards have not yet been attained. Plans to achieve the standards are required under the CAA Amendments of 1977. It is hoped that the material presented herein will assist in achieving progress towards the protection of the public's health through the attainment of these standards.

ACKNOWLEDGEMENTS

I gratefully acknowledge the invaluable assistance of members of the Anchorage Air Pollution Control Authority/Municipality of Anchorage (AAPCA/MOA), Alaska Department of Environmental Conservation (ADEC) and Alaska Department of Transportation (ADOT). Without their continuing cooperation and unfailing efforts the successful completion of this study would not have been realized.

The study was accomplished with the following division of labor. The EPA was primarily responsible for study design and funding, quality assurance development, some field training, data processing and analyses, and report preparation. The AAPCA was primarily responsible for budget and contractor management, sampling initiation and maintenance, data collection and reduction, and quality assurance functions. These efforts were coordinated by George LaMore, Director of AAPCA/MOA and supported by a staff of Stephen Morris, Wes Tindall, Brenda Horn, and Ron King of MOA's Planning Department. Tom Chapple and Leonard Verrelli of ADEC were primarily responsible for providing State input to most study functions and coordinating the implementation of the traffic count program with ADOT and the MOA's Traffic Engineering Department.

The contributions of the National Weather Service/Anchorage International Airport, the control tower crew at the Merrill Field airport, and the meteorological staff at Elmendorf Air Force Base were also greatly appreciated.

Finally, a great debt is owed to the many members of the EPA Regional staff who provided guidance, encouragement, and assistance to the task at hand. Special gratitude is due to both Kenneth Carson and Laurie Fiske for their endeavors at the computer keyboard and Cathy Chavez for her enduring patience in many hours with the word processor.

ABSTRACT

Typically, levels of ambient carbon monoxide (CO) vary widely among the four existing permanent monitoring sites distributed throughout the city of Anchorage. An ambient air sampling program was designed and implemented to clarify and define, if possible, the relationship of carbon monoxide (CO) levels reported from these permanent sites and levels occurring elsewhere in the city. Integrated bag sampling was conducted on weekdays at approximately 50 sites during the interval spanning November 22, 1982 and February 11, 1983. Samples collected from each site were analyzed by the non-dispersive infrared (NDIR) method. Comparisons were then made between data arising from the study sites and the four permanent monitoring sites. A comprehensive quality assurance program was developed and ordered to the study to ensure the collection of data that were of known and appropriate accuracy, precision, representativeness, comparability and completeness.

In largely fulfilling the purpose of the study, the primary conclusions arising from analysis of the study data were twofold: 1) The permanent monitoring network does not adequately characterize either the absolute magnitude of CO levels or the frequency of standards exceedances encountered at an array of locations elsewhere in the study area, and 2) The basic or immediate representativeness of each permanent monitoring site has largely been established.

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INTRODUCTION

Since the onset of ambient air monitoring in 1974, a carbon monoxide (CO) problem has been identified with the city of Anchorage, Alaska. Violations of the standard* established by EPA for the protection of the public's health from ambient CO levels have been routinely recorded at each of the four permanent monitoring sites currently operated in Anchorage. It is estimated that some 90 percent of all the emissions of this colorless, odorless, and tasteless pollutant in Anchorage are directly attributable to motor vehicle exhaust. The persistence and severity of this problem have aroused and garnered the active concern of the general public, automobile industry and virtually all levels of government, local to federal.

Additional information relative to the magnitude and spatial distribution of this problem was sought to define the relationships between CO levels measured at the permanent sites and concentrations elsewhere throughout Anchorage. Accurate knowledge of this kind is critical in preparing an effective and comprehensive abatement strategy insofar as the interpretation of the ambient record bears heavily on the nature, scope and degree of control required.

The three entities with jurisdictional interest in the issue, the Municipality of Anchorage(MOA), the Alaska Department of Environmental Conservation (ADEC) and the U. S. Environmental Protection Agency (EPA) conceived and conducted a sampling study towards resolving the representativeness of the permanent monitoring network. This report presents the major results and conclusions from that study.

STUDY PURPOSE AND OBJECTIVES

The express purpose of the study was to examine and establish, if possible, the representativeness of each site in Anchorage's permanent CO monitoring network in characterizing the magnitude, spatial, and temporal aspects of the city's CO problem. The immediate utility of the information arising from the study would be twofold. It would assist in establishing a credible technical basis for the derivation of a design value for the city. This is the value to which the ultimate control strategy would be targeted for reduction of ambient CO to levels in compliance with EPA's standard. And it would serve in the selection of the permanent monitoring site(s) against which the effectiveness of the ultimate control strategy would be subsequently indexed.

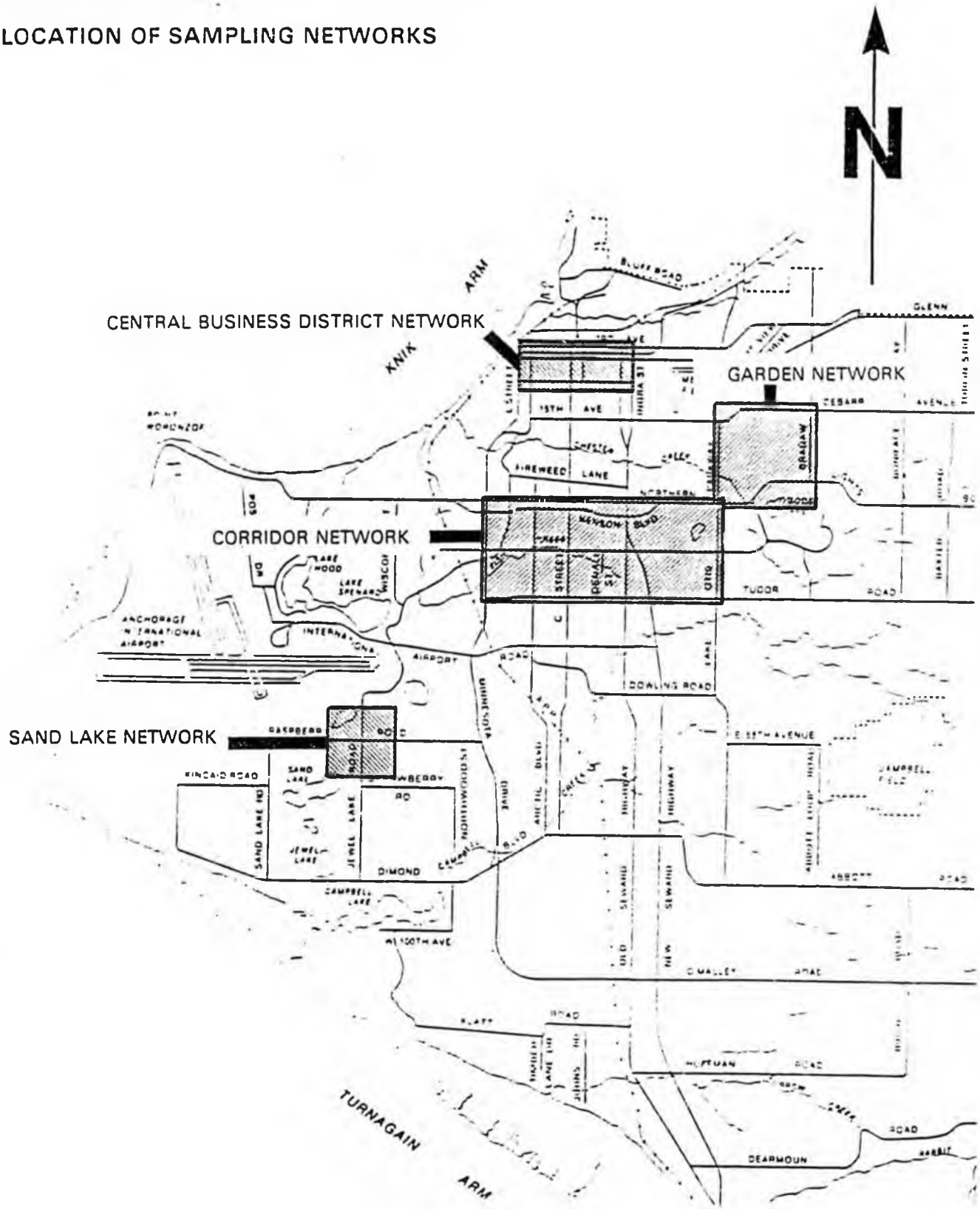
Explicit objectives were developed to ensure that this purpose was fulfilled within the context of intervening time and resource constraints. Particular emphasis was given to the representativeness of the "7th and C", "Spenard", and "Garden" permanent CO sites in recognition of their relative importance in completing study aims. Another primary study objective was to provide for the retrieval of data possessing both high and demonstrable quality and statistically adequate quantity through application of a comprehensive and rigorous quality assurance program.

* The National Ambient Air Quality Standard (NAAQS) for CO is "...10 milligrams per cubic meter (9 p.p.m.) - maximum 8-hour concentration not to be exceeded more than once per year." (40 CFR Part 50)

FIGURE 1

ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

LOCATION OF SAMPLING NETWORKS



STUDY DESIGN

Prior to the onset of actual sampling, a monitoring plan was developed to integrate and implement the various study objectives. The plan was designed to encompass three largely distinct functional components: siting, sampling and data analyses. These respective functions represented the three basic phases through which the study progressed. What follows is a brief description of each of these phases characterizing the study. It should be noted that a more exhaustive treatment of the siting and sampling functions may be found in two support documents: "Anchorage Carbon Monoxide Monitoring Plan 1982-1983" and the "Quality Assurance Plan for 1982-1983 Anchorage CO Study".

SITING METHODOLOGY

This particular study was unique in that it incorporated intensive and simultaneous sampling from the three spatial scales of representativeness most often emphasized in comprehensive CO monitoring programs: micro- (up to 100 meters), middle- (100 to 500 meters) and neighborhood- (.5 to 4 kilometers) spatial scales. Concurrent monitoring in each of these spatial scales provided a profile of CO impacts experienced in the urban core, along major traffic facilities, and residential neighborhoods.

Two terms are used here to discuss the concept of representativeness:

1) "Homogenous representativeness" is used in reference to the airmass over which the concentration of a pollutant is considered uniform.

2) "Analagous representativeness " is used in reference to two or more non-adjoining areas of homogenous representativeness sharing essentially identical pollutant concentration characteristics

There were two principal methods employed in designing the bulk of the study network located in Figure 1. The hot-spot approach, applied primarily to the design of the central business district (CBD) portion of the network and depicted in Figure 2 and Table 1, focused on the issue of analogous representativeness, while the grid technique used to configure the "Garden" (Figure 4 and Table 3) and "Sand Lake" (Figure 5 and Table 4) portions of the network emphasized homogenous representativeness. The "Corridor" network portrayed in Figure 3 and Table 2 was designed using both techniques.

Corollary, but largely subordinate study interests also intervened in the design exercise, and will be identified and discussed throughout the narrative that follows.

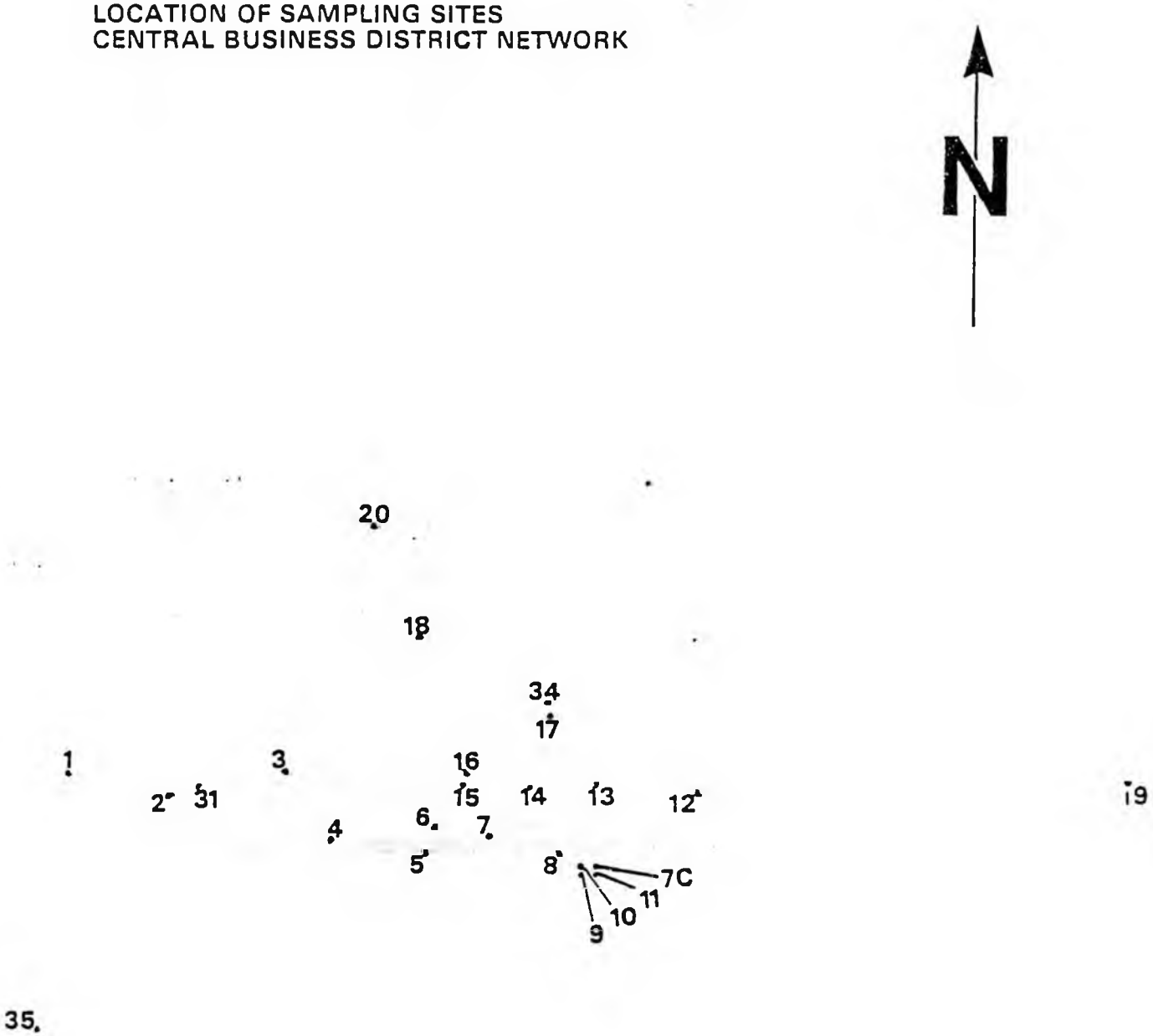
Hot-Spot Screening Technique

Generally, attempts to model absolute concentrations of CO over areas of small dimensions (up to 100 meters) and high emission density have met with little consistent success. Therefore, as in previous Region 10 CO studies, the screening model found in EPA's Carbon Monoxide Hot-Spot Guidelines (EPA 450/3-78-035) was used to identify sites of potentially high, NAAQS threatening CO concentrations and to subsequently configure an effective microscale sampling network for measuring maximum CO concentrations.

FIGURE 1

ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

LOCATION OF SAMPLING SITES
CENTRAL BUSINESS DISTRICT NETWORK



PERMANENT SITE

7TH & C—7C

Table 1

Anchorage CO Study
November 22, 1982 - February 11, 1983

Site Identification
Central Business District Network

Site	Group*	Adjacent Street	Cross Street	Side of St	Type of Sampler	Spatial Scale
1	1	5th Ave	E/O L	N	Integrated	Micro
2	2	I St	S/O 5th Ave	W	"	"
3	2	5th Ave	W/O G St	S	"	"
4	2	6th Ave	E/O G St	N	"	"
5	1	6th Ave	W/O E St	S	"	"
6	1	E St	N/O 6th Ave	W	"	"
7	1	6th Ave	W/O D St	N	"	"
8	1	6th Ave	W/O C St	S	"	"
9**	1	C St	S/O 6th Ave	E	"	"
10**	N/A	C St	S/O 6th Ave	E	"	"
11***	1	C St	S/O 6th Ave	E	"	Middle
12	1	A St	S/O 5th Ave	W	"	Micro
13	1	5th Ave	E/O C St	S	"	"
14	2	5th Ave	E/O D St	S	"	"
15	1	5th Ave	E/O E St	S	"	"
16	2	5th Ave	E/O E St	N	"	"
17	2	4th Ave	W/O C St	S	"	"
18	1	3rd Ave	W/O E St	S	"	"
19	1	5th Ave	E/O Gambell St	S	"	"
20	1	F St	N/O 2nd Ave	E	"	Neighborhood
31	2	5th Ave	E/O I St	S	"	Micro
34	2	4th Ave	W/O C St	N	"	"
35	2	L St	N/O 9th St	W	"	"
Permanent Site						
7th & C	N/A	C St	S/O 6th Ave	E	Continuous	Middle

* - Group 1 sites were sampled a nominal 54 days.
Group 2 sites were sampled a nominal 30 days.

** - Collocated

*** - Collocated with permanent site

ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

LOCATION OF SAMPLING SITES
CORRIDOR NETWORK

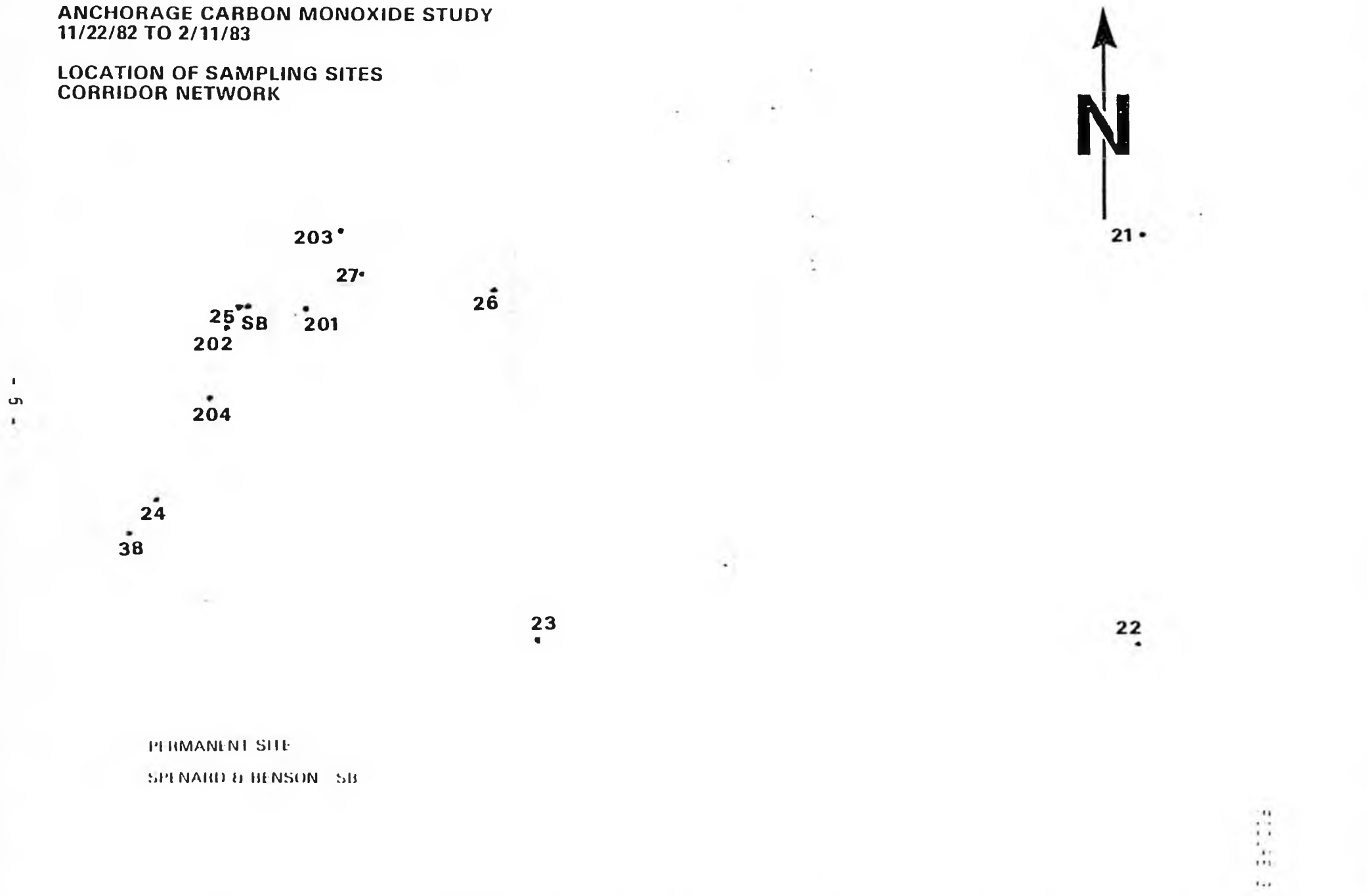


Table 2

Anchorage CO Study
November 22, 1982 - February 11, 1983

Site Identification
Corridor Network

Site	Group*	Adjacent Street	Cross Street	Side of Street	Type of Sampler	Spatial Scale
21	1	Seward	N/O Northern Lights	W	Integrated	Micro
22	2	Tudor	W/O Lake Otis	N	"	"
23	2	Tudor	E/O C St	N	"	"
24	1	Spenard	W/O Minnesota	S	"	"
25**	1	Benson	W/O Spenard	S	"	"
26	1	Benson	W/O C St	S	"	"
27	1	Arctic	S/O Northern Lights	W	"	"
201	N/A	Address:	1101 30th Ave	N/A	Sequential	Mid/Neigh
202	N/A	Address:	3902 Spenard Road	N/A	"	"
203	N/A	Address:	900 W 25th	N/A	"	"
204	N/A	Address:	1411 W 33rd	N/A	"	"
38	N/A	Address:	1807 Mckinley	N/A	"	"
Permanent Site						
Spenard/Benson		Benson	W/O Spenard	S	Continuous	Micro

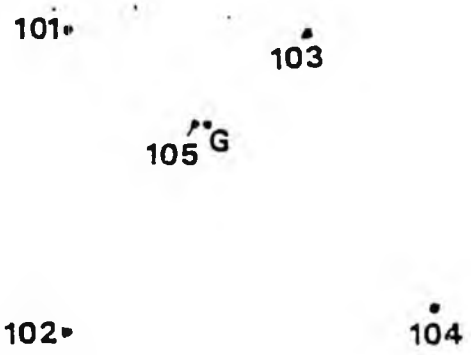
* - Group 1 sites were sampled a nominal 54 days.
Group 2 sites were sampled a nominal 30 days.

** - Collocated with permanent site

FIGURE 1

ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

LOCATION OF SAMPLING SITES
GARDEN NETWORK



PERMANENT SITE

GARDEN – G

Table 3

Anchorage CO Study
November 22, 1982 - February 11, 1983

Site Identification
Garden Network

Site	Adjacent Street	Cross Street	Side of Street	Type of Sampler	Spatial Scale
101	E 15th St	W/O Alder	N/A	Sequential	Neighborhood
102	Alder	S/O E 20th St	W	"	"
103	Rosemary	S/O E 15th St	W	"	"
104	E 20th St	W/O Nichols	S	"	"
105*	E 16th	E/O Garden	S	"	"
Permanent Site					
Garden.	16th St	E/O Garden	S	Continuous	"

* - Collocated with permanent site

FIGURE 8

ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

LOCATION OF SAMPLING SITES
SAND LAKE NETWORK

28

SL

29

30

PERMANENT SITE

SAND LAKE-SL

Table 4.

Anchorage CO Study
November 22, 1982 - February 11, 1983

Site Identification
Sand Lake Network

Site	Adjacent Street	Cross Street	Side of Street	Type of Sampler	Spatial Scale
28	W. 64th St	W/O Cranberry St	N	Integrated	Neighborhood
29	Cranberry St	N/O W. 71st St	E	"	"
30	Caravelle Dr	W/O Crawford St	S	"	"
Permanent Site					
SL*	Raspberry Rd	W/O Cranberry St	S	Continuous	Neighborhood

* - Sand Lake

This screening model is predicated on an extensive array of relatively severe underlying assumptions (low ambient temperature and wind speed, "ideal" receptor location, vehicle composition, etc.). When considered collectively, these assumptions compose a conservative or worst-case scenario for the inducement of CO exceedance potential at subject intersections. Model output is simply in terms of whether an intersection exhibits hot-spot potential. The model does not characterize the nature of this potential with respect to either absolute magnitude or projected frequency of standard exceedance.

The number of intersections identified by the model as potential CO hot-spots far exceeded the number of samplers available to the study. Therefore, each intersection identified to possess potential subsequently underwent a second-tier evaluation towards ranking the entire candidate pool with respect to the adjusted strength of potential. Heavily reliant on previous sampling experience, several factors were subjectively weighted relative to their aggregate contribution to CO concentrations at each intersection. Finally, intersections from this ranked listing were considered against the logistical limitations posed by both the sampling methodology and the spatial distribution of candidate sites.

Each of these samplers was sited in conformance with EPA's siting criteria for monitoring maximum concentrations of CO in a micro spatial scale (40 CFR Part 58, Appendix E).

Grid Design Technique

The grid design technique is a relatively straightforward method of establishing both the homogenous and analogous aspects of pollutant concentrations throughout an airmass. This technique is particularly applicable to the design of a sampling network emphasizing the middle- and neighborhood- spatial scales of representativeness of existing permanent monitoring sites.

The technique used here involved designing a grid of samplers at sites both equidistant from the permanent monitor and each other and in basically comparable physical environments. The dimension of the circumscribing radius was arbitrary. The dimension(s) selected for this study coincided as nearly as possible with the increments EPA uses in defining middle- and neighborhood-scales of representativeness: 100 meters to .5 kilometers and .5 kilometers to 4 kilometers respectively (40 CFR 58, Appendix D). Once the general sampling location had been determined, other pertinent factors were considered in the selection of individual prospective sites towards enhancing inter-site comparability.

Each of these samplers was sited to conform to EPA's siting criteria for sampling in a neighborhood spatial scale (40 CFR Part 58, Appendix E). Due to design peculiarities, probe inlet height for the sequential samplers was approximately two (2) meters lower than the lower limit prescribed by the siting criteria. However, since these sites were sufficiently removed from roadways, this slight probe inconsistency is not thought to have affected the data to any discernible extent.

SAMPLING METHODOLOGY

This function was itself composed of several individual elements including: selection of study and sampling intervals, selection of sampling methods, and quality assurance.

Selection of Study and Sampling Intervals

Ambient CO levels are typically cyclic in nature, revolving through several temporal scales simultaneously, from diurnal to seasonal in duration. In order to optimize the probability of sampling the phenomenon of interest, i.e. high CO concentrations and thereby realize the most effective utilization of resources, a pre-study analysis was performed to determine the seasonal and daily intervals most frequently characterized by maximum CO potential. This was accomplished through a historical review of the data reported from each of the four permanent CO sites in Anchorage during the four previous winter seasons. The results of the review are summarized in Table 5.

TABLE 5 Results of Pre-Study Data Analyses

Permanent CO Site	Months of Greatest Exceedance Frequency (Decreasing Order)	5 Consecutive Days of Greatest Exceedance Frequency	Daily 8-hour or 16-Hour Interval* of Greatest Exceedance Frequency
7th and C	Dec, Jan, Nov, Feb	Monday-Friday	11:00 a.m. - 7:00 p.m.
Spenard and Benson	Dec, Jan, Nov, Feb	Monday-Friday	11:00 a.m. - 7:00 p.m.
Garden	Dec, Jan, Nov, Feb	Monday-Friday	9:00 a.m. - 1:00 a.m.
Sand Lake	Dec, Jan, Nov, Feb	Monday-Friday	N/A

* - Duration of subject interval corresponds to type of sampler used in conjunction with permanent site.

In retrospect, all sampling intervals selected for these sub-networks were largely validated by subsequent sampling data.

Selection of Sampling Methods

Sampling methods were selected which retrieved the types of information that most effectively responded to the study objectives. This, while satisfying a mix of other selection criteria including: direct and indirect resource consumption per data unit, physical and performance specifications, etc.

Two basic types of samplers were employed to collect ambient CO samples: single bag samplers and multiple, consecutive sequencing bag samplers, hereinafter referred to as integrated and sequential samplers respectively. Both samplers operate on the integrated principal where an ambient sample is pumped at a constant rate over the time interval of interest. All bag samples were analyzed via the NDIR (non-dispersive infra-red) method* to yield the "average" ambient CO concentration over the subject interval.

* - EPA-designated reference method: Beckman Model 866 CO Analyzer

The integrated samplers, deployed extensively in the CBD and Corridor portions of the study network, were used to collect two consecutive four-hour "average" samples each study day. The resultant concentrations were then averaged to construct an eight-hour average concentration of CO for comparison against the eight-hour NAAQS. Three of these samplers were modified to collect a single eight-hour bag sample and deployed in the grid about the Sand Lake permanent monitor.

The sequential samplers were located throughout the study network, but primarily in the Spenard and Garden grid networks where a discrete hourly profile was desired for comparison with the focal permanent site and other sites in the grid. These samplers collected 16 consecutive samples allowing for the construction of up to as many as eight overlapping 8-hour intervals each study day for comparison against each other and the standard.

Traffic and meteorological data were also collected over the term of the study. While these data are of particularly critical significance to future analyses of the data, they will not be included in this report.

Quality Assurance

A comprehensive and rigorous quality assurance (QA) program was developed, documented, and implemented to ensure that study data were of known and appropriate quality, completeness, comparability, and representativeness. This program provided for routine measures of accuracy and precision for sampling, analytical, and data reduction functions.

The quality of all meteorological and traffic count data are largely unknown due to the lack of direct control of the data generation operation. The quality is believed to be sufficient for the ultimate intended purpose of the data.

DATA ANALYSES

Several methods exist by which to analyze and compare data from the study sites and the permanent monitors. Two basic approaches are presented in this report to examine the representativeness of the permanent sites. The first approach compares data on a day-to-day basis. Because the study sites were sampled for a single eight- or sixteen-hour period each day, data from the permanent monitors for the identical interval were chosen for purposes of temporal congruity.

The second approach compares data from the entire study interval, regardless of whether the compared data occurred on the same day. This method of analysis lends itself to examining larger patterns and frequencies of CO levels throughout the term of the study while smoothing the daily inter-site variability which can occur especially as a result of meteorological impacts.

The results of the analyses presented here reflect the most significant results and conclusions stemming from a more extensive treatment. Because of time constraints, this expanded treatment of study data will not be compiled into a single report document until some later date.

LIMITATIONS

Even well-designed studies of this nature are subject to uncertainties of which both researcher and reader alike should be cognizant. These qualifications do not necessarily impair the validity of the study results, but rather frames their present and future application and interpretation within the context of appropriate caution. The following uncertainties have been identified with this study:

1) The study spanned only a single CO "season". There is a possibility, albeit remote, that the variety of conditions influencing CO levels (traffic, economic, construction, meteorological, etc.) combined to create a situation grossly anomalous with respect to both previous and succeeding seasons.

Comment: In a general sense, this situation is not thought to have occurred here. Cursory inspection of the two factors to which CO levels are particularly sensitive, traffic volumes and certain meteorological parameters, indicate basic conformity to conditions characterizing previous seasons. However, future construction activities and traffic revisions may impair the long-term utility of site-specific study data by the degree of their cumulative effect on CO levels.

2) Study sampling data was collected daily for discrete eight- or sixteen-hour periods. Just as inter-site relationships may exhibit some degree of daily variability when data are compared for concurrent periods, these relationships may also vary during periods within a day for which comparable study data are largely lacking.

Comment: The pre-study analyses conducted to determine optimum sampling intervals were validated by data actually collected during the study. While these intervals, particularly the eight-hour, may not have wholly accounted for any or all of this potential temporal variability, the study data strongly reflect the intervals most frequently exhibiting the daily maximum concentrations as measured by the focal permanent sites. The glaring exception to this is found at the Sand Lake network which enjoyed a more limited study treatment and where the pre-study analysis was largely ignored for logistical reasons.

3) As referenced previously, the number of intersections identified as possessing CO potential in the pre-study siting exercise far outstripped the number of available samplers. Because of resource and logistical considerations, many of the intersections rated at higher potential were passed over for lower rated ones.

Comment: When reviewing the study results, the reader should note that data for that portion of the network sited to retrieve maximum concentrations in no way reflects all areas in Anchorage thought to possess CO potential. Additionally, the reader should be cautioned not to interpret the proportion of relatively higher impact sites to lower impact sites in the data displays as necessarily characteristic of the severity of CO levels occurring throughout the study area.

4) There were some uncertainties associated with the siting of individual microscale samplers for measuring maximum concentrations. Because CO can be a highly localized phenomemon, especially when considered over micro spatial scales, there is a relatively low theoretical probability of selecting the particular leg and then the particular side of the leg of an intersection at which the maximum concentration most frequently occurs.

Comment: It is possible there are other locations at or near subject intersections that experience consistently higher CO levels than those measured at the study site. Previous experience in evaluating site specific features enhances the probability of proper selection. However, this too is often counterbalanced by difficulties in siting opportunity and/or logistics. On balance then, the data presented herein should not be interpreted to necessarily represent the maximum CO concentrations occurring at any particular intersection. Therefore, caution should be exercised when drawing inter-site and NAAQS comparisons.

5) The study data were generated by ambient air quality sampling methods which are not approved by EPA for use as the primary basis for either NAAQS attainment/nonattainment determinations or the definitive demonstration of control strategy effectiveness.

Comment: There are uncertainties associated with virtually all methods employed to monitor ambient pollutants, EPA-approved or not. While the methods chosen for this study are subject to relatively greater variability in precision and accuracy than the EPA-approved methods located at the permanent sites in Anchorage, special measures were taken towards defining and minimizing it. As discussed later, these measures were really quite successful in yielding a data base of roughly comparable quality to that generated by the permanent network.

6) Gaps in the data record for each study site can impair inter-site comparisons in that data from certain sites may not reflect phenomena of interest which were measured successfully at other sites.

Comment: This is a real problem which we hoped to minimize by sampling over a long interval. What is particularly troublesome in relatively short-term studies of this kind is that the inter-site relationships that are generally well-described by regression analysis for instance may not be so well defined for some relatively isolated but nevertheless important features of interest, such as maximum concentrations. Because of this, gaps in the data record can be critical. Unfortunately, the occurrence of at least some gaps are unavoidable (refer to Table 13 for data capture rates for each site). Every effort was made to minimize the number of these gaps while preserving the fundamental integrity of the data base. Additionally, analysis involving direct comparisons between sites were performed, where possible, using data bases reflecting only concurrently sampled data.

CONCLUSIONS

The major conclusions relative to the primary study purpose are as follows:

1) Carbon monoxide levels at a number of sites throughout the study area exceeded the standard with greater frequency and were of consistently higher magnitude than the sites in the permanent monitoring network for the period of study. The general consensus among the study principals (MOA, ADEC,and EPA) is that this situation is duplicated within a range at an array of other locations throughout the Municipality.

2) When considered in aggregate, the permanent monitoring network frequently exhibited sub-exceedance values when one or more study sites elsewhere in the study area reported standards exceedances.

3) The most severe CO impacts in terms of both magnitude and frequency, were exhibited by microscale sites on larger traffic facilities or corridors.

4) There was typically wide variability in the CO levels between some locations throughout the study area for corresponding intervals. On a number of occasions when one or more microscale study sites measured concentrations exceeding the standard, sub-exceedance values were being measured at other microscale and neighborhood sites.

5) While only certain combinations of study sites from the microscale network were well-correlated when considered on a date-paired (simultaneous) basis, all of these sites, including those collocated with the permanent sites were extremely well-correlated with each other on a rank-paired (season-long) basis.

6) The 7th & C permanent site was relatively representative of the lower level microscale sites and may be at or below levels measured at the neighborhood sites.

7) While the Spenard & Benson permanent site was often representative of study sites reporting CO levels in the mid to upper range (but not the highest range) on a study-long basis, it was not very successful in characterizing levels at other individual study sites on a daily basis. This site is also properly designated as a microscale site, although it may have definite utility in characterizing levels in adjoining (homogenous representativeness) and nearby but non-adjoining (analogous representativeness) neighborhoods with an appropriate correction factor.

8) The Garden permanent site was not unduly influenced by a single and/or immediate CO source, and generally characterized CO levels throughout the adjoining Garden neighborhood grid (homogenous representativeness). It may experience CO levels somewhat elevated over other areas in the Garden grid by virtue of its central location in the emission grid.

9) The Sand Lake permanent site generally characterized CO levels in both the adjoining (homogenous representativeness) and nearby but non-adjoining (analogous representativeness) neighborhoods.

RESULTS AND DISCUSSION

Samples collected during virtually identical periods over a large array of sites affords a characterization of CO distribution over a relatively wide area. Data were analyzed for (1) the relative magnitude of CO concentrations reported at various sites throughout Anchorage and (2) any suggested patterns of ambient levels. Direct comparisons were made with data arising from the permanent monitors. Comparisons were also made in the form of ratios and regression/correlation analyses. Since at most study sites either two 4-hour or 16 hourly samples were collected daily, some measure of temporal variability was also subject to comparative evaluation.

Summary statistics are primarily depicted in the form of tables and box-plots or box-plot/base map combinations which enable a visualization of the spatial and temporal distribution of values for the statistics of interest. The box-plots portray the distribution of subject data as follows: maximum value, 9th decile, 3rd quartile, mean, median (2nd quartile), 1st quartile, 1st decile, minimum value. The treatment of eight-hour average data also includes the number of instances when the standard was exceeded and, when individual sites are considered, the second highest value to which the standard is indexed.

The tables and box-plots do not depict data from all sites at which sampling was conducted. Sites which were sampled either over a very short term or to fulfill relatively minor study objectives were not included.

Finally, the various major analysis sections may not contain identical slates of parameters that underwent analytical consideration. Parameters were chosen that best reflected the critical emphasis of the study.

MICROSCALE STUDY NETWORK: CBD AND CORRIDOR SITES

This first section discusses the results from that portion of the study network sited primarily to retrieve maximum CO concentrations in a micro spatial scale. The microscale network was composed of two rather distinct sub-networks, one located within the general boundaries of the Anchorage's CBD and the other adjacent to outlying (the CBD) traffic corridors. While virtually all of these microscale sites were identical with respect to physical probe siting characteristics (i.e. distance to: nearest traffic lane, nearest intersection, obstructions, ground, etc.), there are several basic features that distinguish the CBD network from the Corridor network: 1) The CBD generally has a higher density of streets with 'significant' traffic volumes, 2) Several CBD sites were located on streets bordered on one or both sides by one-story or higher buildings whereas all of the Corridor sites were located in relatively open, well-ventilated areas, and 3) Streets adjacent to and nearby the Corridor sites typically carried higher traffic volumes than those in the CBD.

As a quality assurance measure of inter-method comparability, study sites [illegible] and 25 were collocated with the 7th & C and Spenard permanent sites respectively. In an effort to bolster the comparability of data actually undergoing analyses (with respect to variability, completeness, etc.), comparisons of data from study sites to the 7th & C and Spenard & Benson

permanent sites were actually referenced to the data record for these integrated sites, hereinafter referred to as site 11/7th&C and site 25/Spenard respectively.

It was recognized from the study's outset that in order to ensure that sampling objectives were effectively and efficiently realized, the study network as originally configured would be subject to periodic revision as a function of ongoing data analysis and resource considerations. Study design prescribed the magnitude and schedule of these network revisions by striking a balance between the statistical integrity (number of cases) and ultimate utility of the study data.

As a result, of the 29 individual study sites evaluated in this exercise, 18 (hereinafter referred to as Group 1 sites) were sampled a nominal 50 days. Group 1 consists of sites 1, 5, 6, 7, 8, 9, 11, 12, 13, 15, 18, 19, 20, 21, 24, 25, 26, and 27. Site 10 was collocated with site 9 and was therefore excused from the exercise. Site 20 was the "background" CBD site and is included here for purposes of contrast and comparison.

The remaining 10 sites (hereinafter referred to as Group 2 sites) were sampled a nominal 30 days. Group 2 consists of sites 2, 3, 4, 14, 16, 17, 22, 23, 34, 31, and 35. Eight sites, 2, 3, 4, 14, 16, 17, 22, and 23 were sampled during roughly the first half of the study. With the exception of site 17, these sites were discontinued because they were redundant with other sites in the study network and were re-sited one or more times in order to fulfill other short-term study objectives. Site 17 was the target of chronic vandalism and was subsequently moved directly across the street at mid-study and re-numbered to 34. Sites 31 and 35 were the only other sites sampled during the second half of the study for which data are considered in this exercise.

Because of the disparate size and contribution of the these two groups, Group 2 data receives minimal treatment in this narrative.

Study-Long Network Statistics

The statistics that follow primarily reflect the characteristics of CO measured at each study site.

Maximum Eight-Hour Averages -

Elevated concentrations of CO were measured not only in the immediate vicinity of the 7th & C and Spenard permanent monitors, but at other sites throughout Anchorage (see Limitations 3 and 4). Figures 6, 7, and 8 and Tables 6 and 7 exhibit the maximum eight-hour averages reported from each site during the study.

Group 1 Sites

(General Discussion)

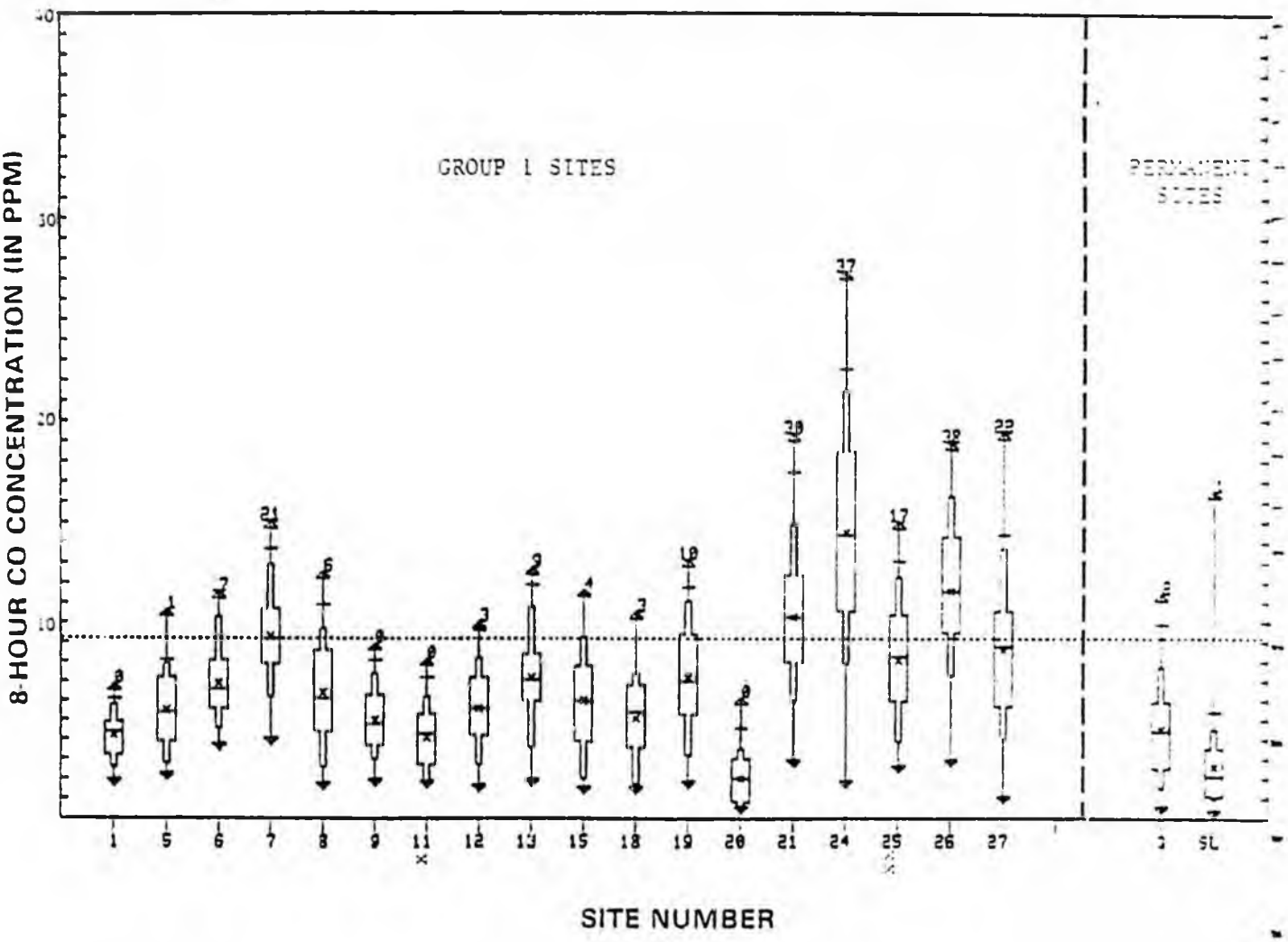
A. Eight-hour maximums for Group 1 sites ranged from 5.2 ppm (site 20) to 27.4 ppm (site 24).

B. Eight-hour maximums for site 11/7th&C and site 25/Spenard were 8.1 ppm and 15.1 ppm respectively.

FIGURE 4

ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

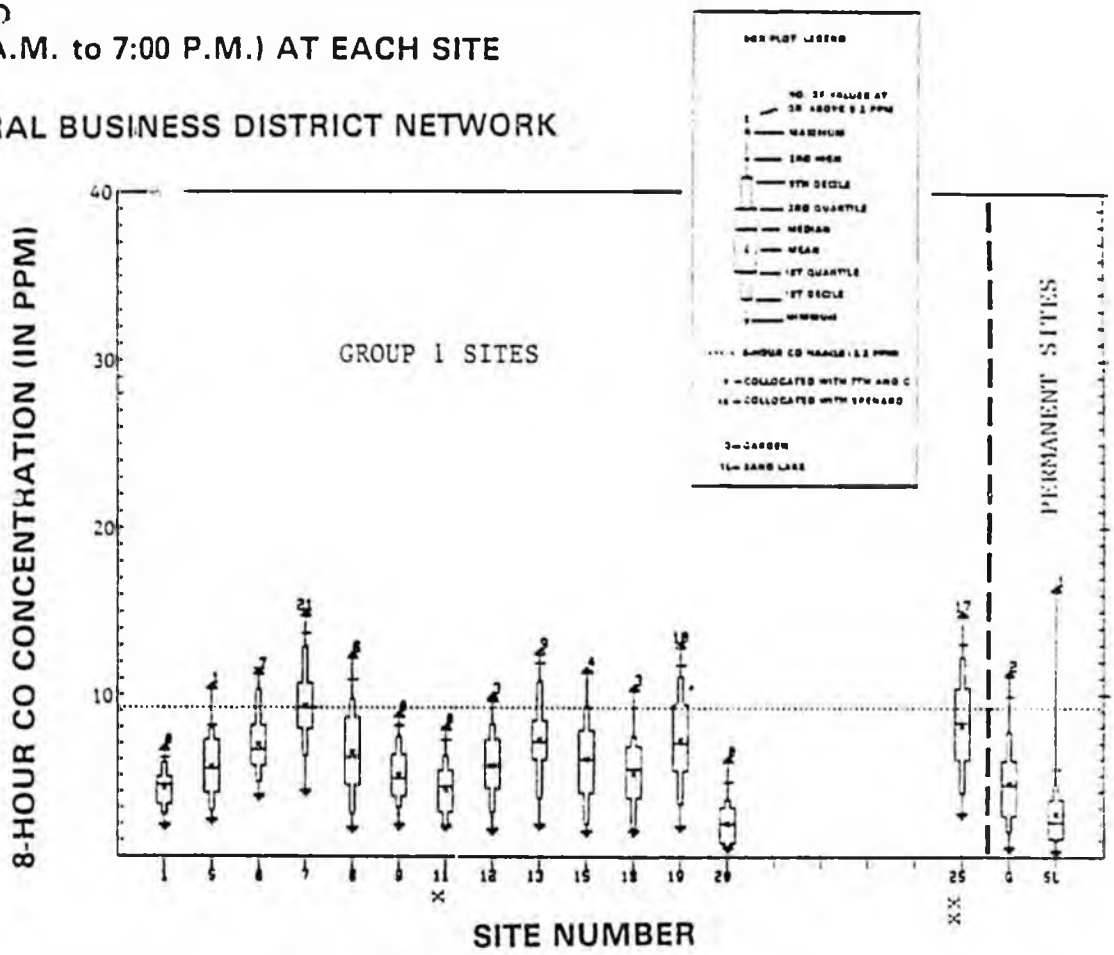
CHARACTERISTICS OF WEEKDAY CARBON MONOXIDE
AVERAGE CONCENTRATIONS FOR AN 8-HOUR PERIOD
(11:00 A.M. to 7:00 P.M.) AT EACH SITE

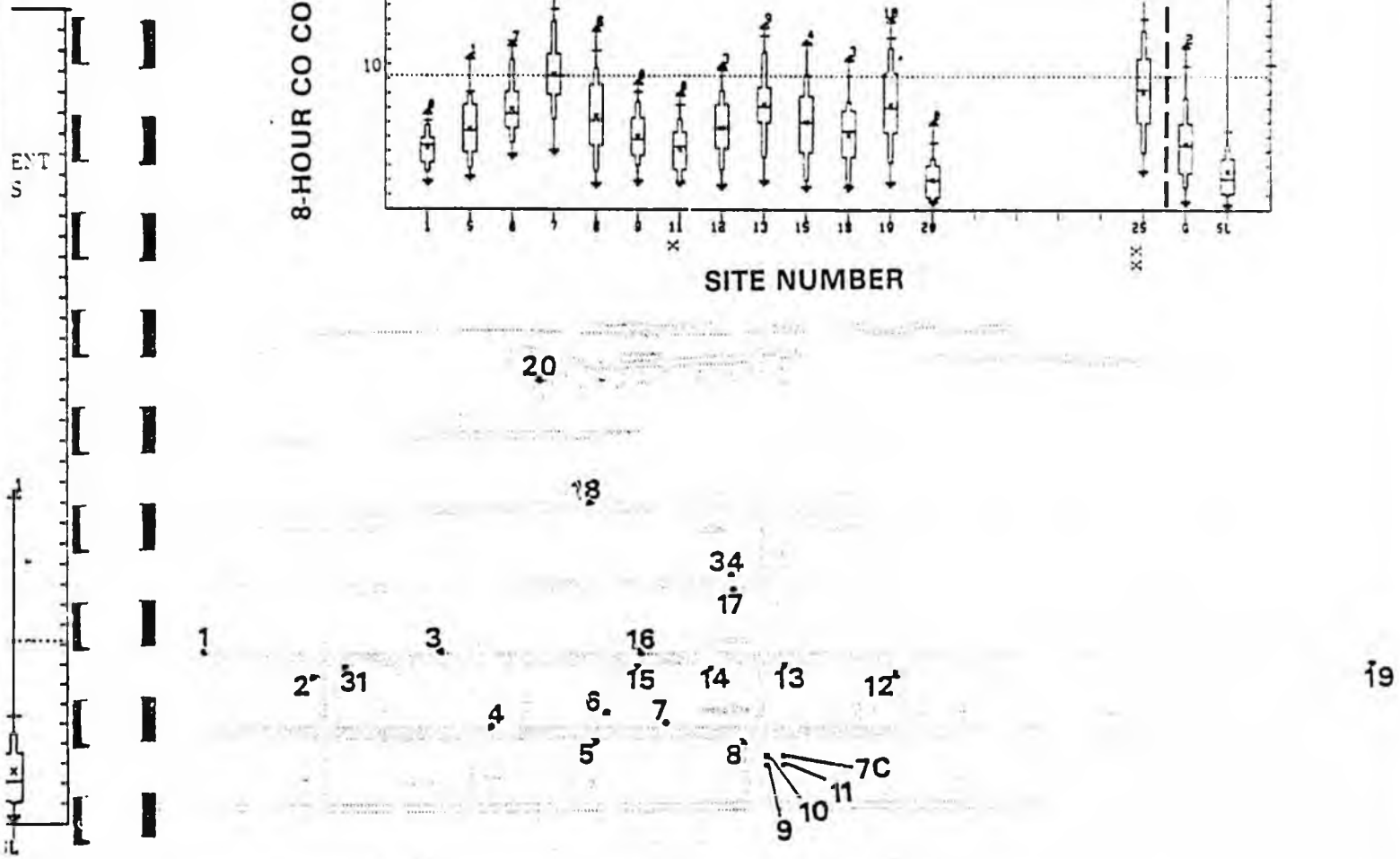


ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

CHARACTERISTICS OF WEEKDAY CARBON MONOXIDE
AVERAGE CONCENTRATIONS FOR AN 8-HOUR PERIOD
(11:00 A.M. to 7:00 P.M.) AT EACH SITE

CENTRAL BUSINESS DISTRICT NETWORK





ANCHORAGE CARBON MONOXIDE STUDY
11/22/82 TO 2/11/83

CHARACTERISTICS OF WEEKDAY CARBON MONOXIDE
AVERAGE CONCENTRATIONS FOR AN 8-HOUR PERIOD
(11:00 A.M. to 7:00 P.M.) AT EACH SITE

CORRIDOR NETWORK

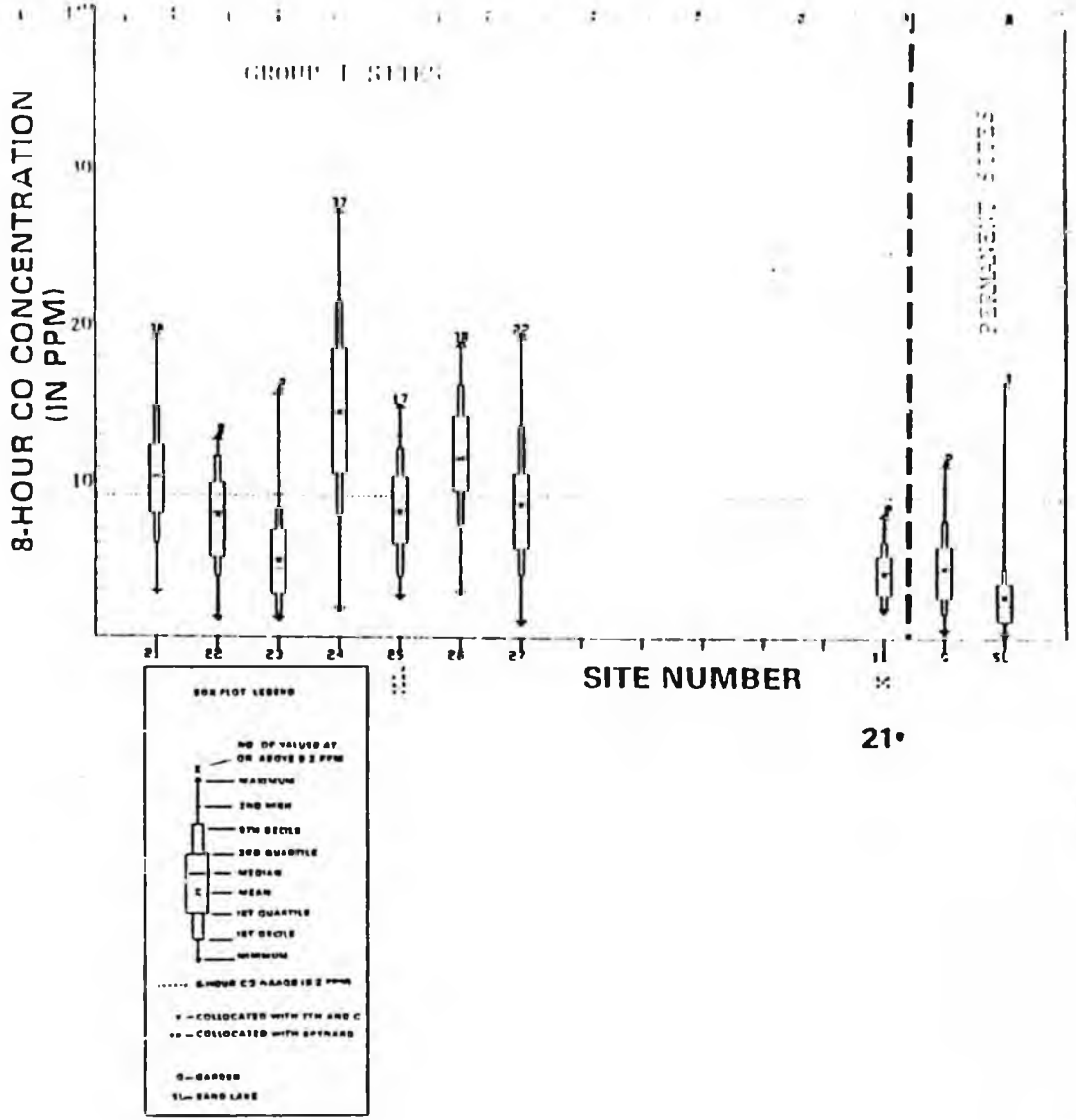


FIGURE 3

(Study/Permanent Site Comparisons)

C. Eight-hour maximums at 15 of the 17 Group 1 sites were 10% to 238% higher than that for site 11/7th&C (9 of which were over 50% higher).

D. Eight-hour maximums at five Group 1 sites were greater than or equal to that for site 25/Spenard (four of which were between 26% and 81% higher).

E. Eight-hour maximums at 11 Group 1 sites were within ± 30% of that at site 25/Spenard.

Table 5 Distribution of Maximum 8-Hour CO Concentration From the Study Sites

Range of Maximum 8-HR CO (In ppm)	Percentage of Group 1 Within Range	Percentage of Group 2 Within Range	Percentage of Group 1 and Group 2 Within Range
0 - 2.9	0%	0%	0%
3.0 - 5.9	0%	0%	0%
6.0 - 3.9	16.7%	45.5%	27.6%
9.0 - 11.9	33.3%	27.3%	31.0%
12.0 - 14.9	16.7%	18.2%	17.2%
15.0 - 17.9	11.1%	9.1%	10.3%
18.0 - 20.9	16.7%	0%	10.3%
20.9 -	5.6%	0%	3.4%

Table 7 Comparison of Maximum 8-Hour CO Concentrations* From Study Sites and Permanent Sites

Site No. Group 1 Sites	Date of Max 8-HR CO Conc.	Maximum 8-HR CO Conc. (ppm)	Ratio of Study Site to Site 11** (8.1 ppm)	Ratio of Study Site to Site 25*** (15.1 ppm)
1	01/05/82	6.9	0.9	0.5
5	01/05/83	10.7	1.3	0.7
6	02/09/83	11.6	1.4	0.8
7	12/20/82	15.1	1.9	1.0
8	01/05/83	12.6	1.6	0.8
9	01/05/83	9.0	1.1	0.6
11**	12/3/82	8.1	1.0	0.5
12	01/05/83	10.1	1.3	0.7
13	12/20/82	12.8	1.6	0.9
15	12/03/82	11.7	1.4	0.8
18	12/03/82	10.5	1.3	0.7
19	12/20/82	13.2	1.6	0.9
20	01/05/83	6.2	0.8	0.4
21	12/03/82	19.4	2.4	1.3
24	12/03/82	27.4	3.3	1.8
25***	12/20/82	15.1	1.9	1.0
26	12/03/82	19.0	2.4	1.3
27	12/03/82	19.5	2.4	1.3
Group 2 Sites				
2	01/04/83	6.0	0.7	0.4
3	01/05/83	6.4	0.8	0.4
4	12/03/82	7.3	0.9	0.5
14	01/05/83	11.5	1.4	0.8
16	12/03/82	10.1	1.3	0.7
17	12/03/82	12.5	1.5	0.8
22	12/30/82	13.1	1.6	0.9
23	12/03/82	16.0	2.0	1.1
31	01/21/83	7.5	0.9	0.5
34	02/03/83	10.5	1.3	0.7
35	01/14/83	8.2	1.0	0.5

* - Measured during the period 11:00 a.m. to 7:00 p.m. on study sampling days only.

** - Collocated with the 7th & C permanent site

*** - Collocated with the Spenard & Benson permanent site.

Second Highest Eight-Hour Averages -

The eight-hour NAAQS for CO is indexed to the second highest eight-hour average concentration of CO measured at a given site in a calendar year. Similar to maximum averages, the levels of second high CO averages were also elevated throughout the study network. Figures 6, 7, and 8 exhibit the second highest eight-hour average measured at each site during the study.

Group 1 Sites

(General Discussion)

A. Eight-hour second highs for Group 1 sites range from 4.6 ppm (site 20) to 22.5 ppm (site 24).

B. Eight-hour second highs for site 11/7th&C and site 25/Spenard were 7.2 ppm and 14.6 ppm respectively.

(Study/Permanent Site Comparison)

C. Eight-hour second highs for 15 of 17 Group 1 sites were between 13% and 213% higher than that for site 11/7th&C (11 of which were over 50% higher).

D. Eight-hour second highs at 5 Group 1 sites equaled or exceeded that for site 25/Spenard (3 of which were 34% to 70% higher).

E. Eight-hour second highs at 8 Group 1 sites were within ± 30% of that for site 25/Spenard.

Table 8 - Comparison of 2nd Highest 8-Hour CO Concentrations* From Study Sites and Permanent Sites

Site No. Group 1 Sites	Date of 2nd Hi 8-HR CO Conc.	2nd Hi 8-HR CO Conc. (ppm)	Ratio of Study Site to Site 11** (7.2 ppm)	Ratio of Study Site to Site 25*** (13.1 ppm)
1	12/22/82	6.1	0.85	0.47
5	02/09/83	8.1	1.13	0.62
6	01/18/83	11.6	1.61	0.89
7	12/03/82	13.7	1.90	1.05
8	01/18/83	10.9	1.51	0.83
9	11/29/82	8.1	1.13	0.62
11**	02/01/83	7.2	1.00	0.49
12	12/03/82	9.6	1.33	0.73
13	12/21/82	11.9	1.65	0.91
15	12/13/82	11.4	1.58	0.87
18	01/05/83	10.2	1.42	0.78
19	01/05/83	11.8	1.64	0.90
20	12/03/82	4.6	0.64	0.35
21	12/20/82	17.5	2.43	1.34
24	12/17/82	22.5	3.13	1.72
25***	02/01/83	13.1	1.82	1.00
26	02/01/83	18.6	2.58	1.27
27	12/23/82	14.4	2.00	1.10
Group 2				
2	12/13/82	5.9	0.82	0.45
3	01/04/83	6.0	0.83	0.46
4	12/16/82	6.4	0.89	0.49
14	12/03/82	11.1	1.54	0.85
16	01/04/83	9.7	1.35	0.74
17	12/13/82	9.3	1.29	0.71
22	12/09/82	11.7	1.63	0.89
23	01/05/83	9.3	1.29	0.71
31	01/31/83	6.8	0.94	0.52
34	02/01/83	10.4	1.44	0.79
35	01/18/83	5.7	0.79	0.44

* - Measured during the period 11:00 a.m. to 7:00 p.m. on study sampling days only.

** - Collocated with the 7th & C permanent site

*** - Collocated with the Spenard & Benson permanent site.