



ENVIRONMENTAL STRATEGIES FOR METRO-DENVER

An Integrated Environmental Management Project

**Report to the
ESP Advisory Committee**

ISSUE PAPERS

Indoor Air Quality • Outdoor Air Quality • Water Quality
Solid and Hazardous Waste • Environmental Lead

Prepared by ESP Staff
April 1988

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ISSUE PAPERS

Background Information on 19 Environmental Issues
Facing Metropolitan Denver

Prepared for the Environmental Strategies Project
Advisory Committee

APRIL 1988

by ESP Staff

Ken Lloyd, Project Director
Environmental Protection Agency
Region VIII

U.S.EPA REGION 8
Technical Library 80C-L
999 18th Street, Suite 500
Denver, CO 80202

PLEASE NOTE

The results described in this report should only be considered within the context of discussions of the Environmental Strategies Project. Consistent with the original ground rules of the ESP Advisory Committee, we strongly recommend that Committee members and Work Group participants not discuss or distribute the information with individuals not associated with the project until the Advisory Committee as a whole has had a chance to discuss the implications.

This material can easily be misinterpreted, and if misconstrued could jeopardize the ultimate goal of the project -- an objective discussion comparing environmental issues in the Denver metro area.

INTRODUCTION

Environmental Strategies Project Issue Papers

The issue papers contained in this document provide a brief overview of topics being considered by the Environmental Strategies Project (ESP). These papers were prepared for the ESP Advisory Committee to supplement their understanding of metro Denver environmental issues. As such, these papers are intended only as snapshots of each topic, not exhaustive descriptions.

For each of the selected topics, the issue papers outline the findings of the ESP work groups and background risk assessment reports where such work was performed. The risk assessments, which were performed for 13 of the 19 issues discussed herein, used existing data to develop rough estimates of the health risks posed by certain pollutants.

Several caveats are needed to put the ESP risk assessment results in proper context. These analyses were conducted to highlight major differences between the issues. The results are not intended as accurate estimates of the risk. In most cases upper-bound estimates were used for worst case comparisons. The actual risks are probably lower than the upper-bound estimate. The lower-bound in each case may be zero, but the lower-bound estimates given are probably more reasonable.

The ESP risk assessments did not address all potential health effects, but attempted to deal with significant health concerns related to these issues. Other limitations of the risk assessments are described in the issue papers. Additional detail on the risk assessments are available in full reports prepared for the ESP.

In addition to information on health effects, the issue papers contain a brief description of economic/welfare effects and ecological effects associated with each issue. The papers also present information on environmental management factors, including public perception and political pressure, regulatory status, and possibilities for further control.

The issue papers were prepared by ESP staff and reviewed by EPA, state, and local program managers, whose assistance is greatly appreciated. The ESP staff, however, is solely responsible for the content of the issue papers.

A further description of the information presented in the issue papers is provided in the outline below.

ESP Issue Papers

Definition of Categories of Information

I. ISSUE DESCRIPTION

Brief overview of the issue in the Denver metropolitan area and potential health and environmental effects.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

Where the ESP performed a risk assessment on an issue, this section describes the analytical approach, information on human exposure, and impact on human health used in the ESP assessment.

2. Other Health Issues/Limitations of the ESP Analysis

Brief overview of health issues not addressed in the ESP analysis; uncertainties and limitations of the ESP analysis

B. Economic/Welfare Effects

Potential effects of the problem, if unabated, on the area economy and economic development opportunities; impacts on property, materials, and quality of life.

C. Ecological Effects

Impacts on ecosystems resulting from habitat modification and pollution. Both plants and animals may be effected in fresh water, terrestrial, and avian systems.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception and Political Pressure

Description of the extent of public concern; degree to which it is expressed.

B. Regulatory Status

1. Legal Requirements: brief outline of federal and state statutes and regulations; pending regulatory changes.
2. Current Activities: brief overview of specific pollution reduction strategies being pursued by federal, state, and local authorities; special initiatives by public and private organizations
3. Public Expenditures: federal and state expenditures for pollution reduction--Fiscal Year 1988

C. Possibilities for Further Control

Other potential control options

IV. WORK GROUP FINDINGS

Gaps in technical data and other findings identified by the ESP work group on the issue.

Issue Papers
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A. INDOOR AIR QUALITY

1. Radon in Homes and Buildings
2. Environmental Tobacco Smoke
3. Other Indoor Air Pollutants

STAFF CONTACT:

Bob Simmons 293-1619

RADON IN HOMES AND BUILDINGS

I. ISSUE DESCRIPTION

Radon is a colorless, odorless, radioactive gas produced by the spontaneous decay of heavy elements Uranium and Thorium that are found naturally in soil and rock. Once emitted, the radon gas can migrate from the soil, through cracks and other foundation openings, and ultimately into buildings where it is trapped. While trapped inside a home or other building, the radon gas continues to decay, forming short-lived radioactive progeny of radon that can attach to sensitive lung and bronchial tissues when inhaled. Alpha particles emitted by these progeny can impact cell tissue and can cause lung cancer.

Monitored in the Denver area suggests that the current lifetime cancer risk from indoor exposure to radon progeny is significant and may affect most residents. However the problem can be corrected with readily available solutions.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

In the spring of 1987 EPA sponsored a monitoring program that measured radon levels in homes in Colorado and nine other states. Two-day samples from 272 homes in the Denver metro area were gathered by the Colorado Department of Health and the Colorado Geological Survey as part of the Colorado effort.

Data from this study were used in a risk assessment model developed by ESP staff with assistance from local technical experts. The model is based on an extensive body of health data from epidemiological studies of uranium miners exposed to radon in Colorado and around the world over the past 40 years.

Several factors can influence the estimation of the magnitude of cancer risks from radon. The model employed in this analysis accounts for these factors and allows for their variation in order to make the estimates more realistic. Factors considered include:

- o Range of cancer potency risk factors from studies conducted by EPA, the National Academy of Science, the National Institute for Occupational Safety and Health, and the International Commission on Radiological Protection;

- o Seasonal variation of radon exposure levels;
- o Time people spend in three different breathing environments -- indoor home, other indoor areas outside the home, and outdoors;
- o Lower radon concentrations found in the upper levels of homes as compared to the basement where most monitoring is done;
- o Percentage of radon progeny that remain in the breathable air instead of attaching to room surfaces (i.e., equilibrium rate);

The knowledge, experience, and informed judgments of local technical experts were used to apply the model and estimate the lifetime cancer risks to the Denver population. Many of these experts are health professionals who have been involved in Colorado radon issues since the late 1960's.

o Information on Human Exposure

The human exposure pathways to radon progeny are found almost everywhere. Highest concentrations are usually found indoors in basements and lower levels of unventilated structures during the spring and winter months. While outdoor exposures are generally lower than in most homes, they can still be significant in the calculation of lifetime risk. Most people typically spend 10% to 25% of their time outdoors, with about 50% of the remaining indoor time spent in their own home.

EPA has recommended a radon action level in homes of 4 picocuries per liter of air (pCi/l), above which a homeowner should consider taking additional steps. The average radon concentration measured in the 272 Denver area homes monitored was about 5 pCi/l. The lowest levels found in the sampled homes were about 0.5 pCi/l while the highest level sampled was about 40 pCi/l. Since these data were gathered a few homes have been found with initial levels above 100 pCi/l.

It is currently not possible to identify which homes might have elevated levels of radon without monitoring each structure. High radon levels were found throughout the metro-area.

o Impact on Human Health

The primary impact of inhaling radon progeny over a lifetime is the possibility of premature death resulting from lung cancer.

Applying the risk model to the 272 homes monitored resulted in an average individual cancer risk of about one in 100 if exposure to these levels of radon continued over a lifetime. The

distribution of risk for most of the 272 households tested ranged from a low of 3 in 1000 to a high of 3 in 100, though there is a small number with risks on the order of 7 in 100. Every household measured has some radon resulting in some level of lifetime cancer risk.

2. Other Health Issues/Limitations of the ESP Analysis

While the radon risk analysis is based on solid data using a realistic modeling approach, there are still several uncertainties and limitations that impact estimated health risks for Denver-area residents. These are summarized below:

The analysis assumes people will continue to be exposed to current radon levels over their lifetime -- without correction.

The additional risk to cigarette smokers who have in the past been exposed to elevated levels of radon is not included in the risk estimates. Many researchers believe that the combined effects of exposure to tobacco smoke and radon are multiplicative (i.e., the combined risk is greater than the sum of the two individual risks).

The radon monitoring data used to estimate risks are short term (2-day) samples instead of the year-long samples preferred for estimating lifetime exposure. The seasonal corrections applied in the model have since been found comparable to a year-long radon monitoring effort recently completed in Fort Collins.

The radon sample size was limited to 272 homes monitored in the Denver area instead of the 595 planned. However, additional monitoring conducted this spring does not appear to change the result.

The risk calculation method that was used to estimate lifetime risk assumes that the epidemiological data from uranium miners are transferable to the home environment. One of several possible differences is the evidence that indicates that the percentage of more toxic radon progeny not yet attached to air-borne particles may in fact be higher in the cleaner air found in homes, resulting in more harmful radon progeny being inhaled. It is not clear whether the combined effect of all of the differences between homes and uranium mines would result in higher or lower cancer risk. More basic research is needed in order to understand these differences.

The analysis includes the additional risk that can occur when children are exposed. Some researchers are now suggesting, however, that if radon exposures are reduced while children are young they may be able to recover somewhat and thereby reduce their lifetime risk.

B. Economic/Welfare Effects

A temporary loss of property value can occur until any necessary retrofit is completed, which in turn may raise the cost of housing.

An area-wide loss to the Colorado economy could occur if the national perception were to shift toward a belief that, because of radon problems, Colorado is not a desirable place to live or relocate businesses.

C. Ecological Effects

There are virtually no additional effects on the natural environment -- radon has historically been as much a part of the planet as the planet itself.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

The population as a whole has a low but growing awareness of radon as a health problem that may be affecting them. When individuals discover they have elevated levels of radon in their home, their reaction is mixed, ranging from "a" to "p" -- apathy to panic.

Political pressure so far is small but polarized. On one hand, a health concern segment is expressing appeals for action. On the other hand, an economic segment is cautioning that over-reaction could create economic problems, particularly in the real estate market.

B. Regulatory Status

1. Legal Requirements

No statutory authority specific to radon exists yet. Legislation is pending in the U.S. Congress to share the cost of establishing state radon technical assistance programs. The Senate passed a bill last summer, but a companion bill in the House remains in committee. Pressure is also being applied for a health-based standard below the current EPA action level of 4 picocuries per liter. Many states are considering radon statutes, although Colorado has yet to do so.

2. Current Activities

Formal comprehensive radon control strategies have not yet been developed state-wide or for the Denver area. Limited technical assistance is being provided on request by local,

state, and federal environmental health organizations. The current primary method of radon control occurs when private firms perform radon monitoring and corrective retrofit at the request of homeowners and building managers who can afford it.

The Governor's Indoor Radon Policy Task Force was formed during the summer of 1986 and remains in place to investigate radon issues and influence Colorado policy. Some localities are considering building code requirements for new construction. Local building and trade associations are considering their own initiatives. Some financial and relocation institutions require screening test measurements of radon activity to be below 4 picocuries per liter before a home is purchased.

EPA is currently sponsoring a radon risk communication research project with the University of Colorado. This joint effort aimed at developing and testing the effectiveness of several radon risk communication protocols applied to the Denver area.

3. Public Expenditures

State and local agencies are not yet funded specifically for regulatory or technical assistance radon efforts.

C. Possibilities for Further Control

Most professionals in the field believe that most of the problems can be solved in a five year period. There are cost-effective solutions available for remediating individual radon problems. Solutions usually involve sealing foundation cracks and venting or pressurizing basements. An average cost of retrofit for a Colorado homeowner varies from \$300 to \$500, with a few severe cases costing as much as \$5,000.

The ultimate solution to the problem depends heavily upon: (1) providing effective risk and solution communication to homeowners and building managers who can take action, (2) identifying high radon homes early in the effort, (3) establishing an institutional method for providing technical assistance, and (4) formulating a comprehensive radon control strategy.

IV. WORK GROUP FINDINGS

The ESP Indoor Air Work Group, with support from local technical experts, developed three main messages after consideration of radon issues in the Denver area:

- o Lifetime cancer risks from radon are high, but relatively easy to resolve;

- o It is important to deal with our radon problem in a positive way that does not cause panic to people and the economy;
- o It is important to simultaneously communicate both the problem and the solution to those who can and should take action.

The Work Group further recommended that a long-term radon monitoring program be conducted in the Denver area. This will supplement the existing short-term data with data collected over one year in homes, other public buildings, and outdoors. The monitoring would answer some of the remaining questions on which control needs should be emphasized (homes vs. public buildings, structures located on geological hot spots, low-income housing, etc.).

The Work Group believed the additional data should be collected before communicating final risk estimates because of the public and economic sensitivity to the radon problem. Interpretation of the data will help design and implement institutional strategies needed to address the problem.

ENVIRONMENTAL TOBACCO SMOKE (ETS)

I. ISSUE DESCRIPTION

The high cancer risks incurred voluntarily by smokers of tobacco products are well known since the Surgeon General's 1964 report. It is the leading cause of lung cancer. Nonsmokers are also exposed to lung cancer risk from tobacco smoke, particularly in indoor environments. Many of our state, local, and federal environmental health professionals believe this largely involuntary exposure to environmental tobacco smoke is the largest environmental contributor to lung cancer -- along with indoor radon.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

No risk analysis specific to Denver was done for ETS. Literature surveys of national data and risks were performed. This work was reviewed and related to the Denver area by experienced Denver area health professionals and a panel of four national experts on indoor air pollution assembled to advise the Indoor Air Work Group.

o Information on Human Exposure

Individual exposure to ETS varies significantly depending on the presence of tobacco smokers in indoor environments. Most people appear to spend 75% to 90% of their time breathing indoor air.

o Impact on Human Health

The 1986 Surgeon General's report on smoking, unlike the original 1964 report, focused more on the health risks of exposure to Environmental Tobacco Smoke (ETS). Nationally the range of individual cancer risk varies from a low of one in 10,000 to a high of three in 100 of acquiring lung cancer from exposure to ETS. A related National Academy of Science study found that non-smoking spouses of smokers have a 25% greater chance of contracting lung cancer than those married to nonsmokers. Nationally 5,000 lung cancer deaths per year are attributed to ETS.

For Denver, no major reasons have been found to suggest that Environmental Tobacco Smoke is any less of a problem for Denver area residents than is reflected in the national data.

Current research suggests a link with prior indoor radon exposure that increases the lung cancer risk for tobacco smokers and those exposed to ETS that is greater than the sum of the risks from exposure to each separately.

2. Other Health Issues/Limitations of the ESP Analysis

The analysis does not provide hard data on exposure to ETS that is specific to the Denver population; instead it relies on the assumption that the Denver risks are similar to national risks.

B. Economic/Welfare Effects

Businesses and service establishments may suffer economic damage if indoor environments free of ETS are not provided for employees, customers, and other users; particularly as public awareness of ETS problems continue to increase.

Some businesses may experience economic losses as ETS free environments are provided. The losses may occur consistent with the extent to which the business relies on consumers that are hardcore smokers with other alternatives.

Some materials such as clothing, furniture fabrics, and drapes may lose their value or require cleaning to eliminate soiling and smells from ETS exposure.

C. Ecological Effects

No deleterious effects are known for the outdoor ecology.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

The public appears to be more aware of the lung cancer risk from voluntary "first hand" smoking than they are of the risks from involuntary "second hand" exposure to ETS.

Public concern about ETS is growing nationally and in Denver -- customers and employees are demanding smoke free indoor environments. There are a few organized interest groups lobbying the state legislature for ETS restrictions. These concerns are supported locally by health professionals.

B. Regulatory Status

1. Legal Requirements

Nationally more than half of the states have passed laws restricting smoking in public places. The private and the public sector is also moving their workplace and employment practices in that direction.

Colorado has not yet adopted an ETS statute but is expected to continue working on bills that have been introduced in the past.

A federal ban prohibits smoking on scheduled airline flights with durations of two hours or less.

So far 28 Colorado communities have passed ordinances restricting smoking in the workplace or public places. In the Denver area, 14 communities and 3 counties have ETS restriction in place. They are: Boulder, Longmont, Denver, Westminster, Arvada, Aurora, Golden, Englewood, Lakewood, Thornton, Louisville, Wheatridge, Broomfield, Littleton, Boulder County, Jefferson County, and Arapahoe County. Most of the ordinances restrict smoking in the workplace, in portions of larger restaurants (with seating over 25, 30 or 50 depending on the community), in stores and public places, and in supermarkets.

2. Current Activities

Smoking is prohibited in some public buildings and in places of employment.

3. Public Expenditures

Very little is spent specific to ETS.

C. Possibilities for Further Control

Opportunities exist to extend smoking control strategies being started locally and nationally.

An indirect limit on the control of ETS depends in part on the extent to which indoor smoking of tobacco can be reduced at the sources. Assistance programs can be made available to smokers who want to quit smoking. National evidence suggests that more than half of the current smokers would like to quit. Nicotine addiction is being recognized as a serious physical addiction by the Surgeon General and other researchers, so "kicking the habit" can be very difficult for some smokers.

IV. WORK GROUP FINDINGS

The Indoor Air Work Group found that the health risk evidence for tobacco smoking and subsequent Environmental Tobacco Smoke exposure is sizeable enough to warrant community focus on control efforts rather than major efforts to research ETS risks specific to the Denver area.

The Work Group recommended that the Environmental Strategies Project research and document the available national and local risk and solution information into a communication package that could assist and focus control efforts.

OTHER INDOOR AIR POLLUTANTS

I. ISSUE DESCRIPTION

A variety of potentially harmful air pollutants are known to be present inside homes and other buildings. This type of contamination is now referred to as indoor air pollution, and is receiving increasing attention from federal and state health officials.

Other indoor air pollutants is the third category of indoor air pollutants considered by the Denver Environmental Strategies Project. It is the composite of all other indoor air pollutants remaining after (1) Environmental Tobacco Smoke and (2) Radon are considered separately. These include: asbestos; formaldehyde; lead; volatile organic compounds (VOC's); pesticides; oxides of carbon, nitrogen, and sulfur; particulate matter, and biological contaminants.

Sources of indoor air pollution are numerous and include: building materials, solvents, outdoor air, and pollutants from combustion sources like furnaces and stoves.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

No monitoring or analysis specific to the Denver area was done. Instead, the ESP took advantage of the expertise on the Indoor Air Work Group and information available through a search and analysis of national literature. Additionally, four national experts on indoor air pollution were invited to advise the Indoor Air Work Group on what problems and solutions could be expected in the Denver area based on their experience.

o Information on Human Exposure

Individual exposures vary significantly depending on what sources of pollutants are present in the indoor environment. Most people appear to spend 75% to 90% of their time breathing indoor air.

o Impact on Human Health

Nationally, individual cancer risks from some of these indoor air pollutants can vary from 1 in a million to as high as

1 in a thousand. For example the California Indoor Air Quality Program regards Volatile Organic Compounds together with Environmental Tobacco Smoke as second only to Radon in health priority concern. Taken all together, the abundance, diversity and prevalence of these pollutants suggest a high risk potential for many structures.

These pollutants are also associated with a number of non-cancer health problems that include lung disorders, headaches, neurotoxic effects, and reduced attention span.

2. Other Health Issues/Limitations of the ESP Analysis

The ESP analysis does not provide hard data on the composite of indoor air pollutants that is specific to the Denver population. It relies instead on the assumption that the Denver risks are similar enough to national risks.

B. Economic/Welfare Effects

Property values can be temporarily reduced for some indoor air pollutants that require retrofit of permanent building materials, such as asbestos and lead paint.

Seldom known and not fully understood effects on productivity, mental and emotional capability, and quality of life are believed to occur.

C. Ecological Effects

No deleterious effects are known for the outdoor ecology.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Public understanding and perception of indoor air problems in the home and other buildings is very limited as is public pressure to address the indoor air pollution issue. There are no obvious public or professional champions.

B. Regulatory Status

1. Legal Requirements

There is currently a limited federal role for pollutants in regard to indoor air pollution. EPA currently regulates asbestos and OSHA has regulatory responsibilities for indoor environments in the workplace. HUD has some authority with building standards under the Clean Air Act and the Toxic Substance Control Act.

A more comprehensive Indoor Air Quality Act of 1987 was introduced in the U.S. Senate by Senator Mitchell last summer. In 1983 Congress formed an Interagency Committee on Indoor Air Quality.

2. Current Activities

Limited technical assistance is provided by area health professionals to home and building owners on request.

3. Public Expenditures

Very little is spent specific to indoor air. Mitigation costs are typically incurred by home and building owners.

C. Possibilities for Further Control

An area-wide strategy focusing on risk and solution communication, technical assistance, and research appears plausible.

IV. WORK GROUP FINDINGS

The Indoor Air Work Group believed the risks from individual and combined indoor air pollutants are high and getting higher, but are relatively easy to resolve. They stressed the importance of simultaneously communicating both the problem and the solution to those who can and should take action. Concern was also expressed that the other indoor air pollutants appear to be a newly emerging area of real concern that is not getting much attention -- as was once the case for ETS and radon.

The work group recommended that the Environmental Strategies Project research and document the available national and local risk and solution information into a communication package that could assist and focus control efforts.

B. OUTDOOR AIR QUALITY

1. Carbon Monoxide
2. Fine Particulate Matter
3. Ozone
4. Air Toxics

STAFF CONTACT:

Patrick Cummins	293-1621
Ken Lloyd	293-1734

CARBON MONOXIDE

I. ISSUE DESCRIPTION

The metro Denver area frequently exceeds EPA's 8 hour air quality standard for carbon monoxide (CO) and registers CO concentrations that are among the highest in the country. Motor vehicles are the major source of CO emissions. CO concentrations are particularly high during the winter in the downtown and other heavily urbanized portions of the city. The area's altitude, topography and winter meteorological conditions all contribute to the severity of Denver's CO problem.

II. IMPACT ASSESSMENT FACTORS

B. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

The impact of carbon monoxide on public health in Denver was evaluated based on a review of the literature on CO-induced health effects. The information from the literature was considered with respect to the level of exposure likely to be experienced by people living in Denver.

o Information on Human Exposure

In 1982 EPA sponsored a Personal Exposure Monitoring (PEM) study in Denver in order to estimate actual levels of exposure to CO by the general population. This involved actual measurements of CO exposures to a sample of subjects throughout their everyday personal activities.

The results of this study and a companion effort in Washington, D.C. indicate that the effects of personal activities and actual CO exposures in microenvironments greatly influence personal exposure. CO exposures in microenvironments associated with motor vehicles, such as riding in or working with vehicles or walking along busy streets, are higher than exposures in microenvironments not associated with motor vehicles.

The Denver study also found that most microenvironment exposures to CO are influenced to some degree by ambient levels, but only indirectly. Indoor sources of CO, such as gas stoves, smokers, and attached garages, can also be significant determinants of individual CO exposure.

o Impact on Human Health

The major health impacts expected to result from exposure to carbon monoxide at levels typically found in metro Denver include cardiovascular and neurobehavioral effects. Results from the Denver PEM study indicate that individuals living in the metro area are exposed to levels of CO that at times may be sufficient to result in these effects.

Cardiovascular effects primarily affect persons already suffering from certain types of heart disease and include aggravation of angina. Reduced vigilance (ability to concentrate, react, etc.) is the primary neurobehavioral effect, and this may be a problem for healthy people as well as for those with pre-existing medical conditions.

2. Other Public Health Issues/Limitations of the ESP Analysis

Information on the level of exposure to CO that will cause a specific health problem is highly uncertain. As a result, it is not possible to accurately predict the likelihood that an individual will actually experience an adverse health effect given a certain level of CO exposure. Instead, we simply know that above a certain CO level, a person may experience an effect.

EPA is undertaking a periodic review of the ambient air quality standard for CO. As part of this review, the Agency is reviewing the most recent literature and clinical studies on the health effects of CO, including the effects at high altitude.

B. Economic/Welfare Effects

Though not a visible deterrent like the "Brown Cloud," Denver's CO problem has nonetheless had an adverse effect on the area's image. Much has been made of Denver's ranking at the top of "EPA's list" of non-attainment areas for CO. Combined with the concern over the Brown Cloud, the CO problem in Denver has been the source of widespread concern on the part of business and political leaders because of the potential adverse on economic growth and development. Several surveys of companies around the country have reported that Denver's air quality would negatively affect economic development and business location decisions, although air quality does not appear to be the overriding factor.

Since the Denver area does not yet attain EPA's ambient standard for CO, the metro area runs the risk of sanctions being applied by EPA. Highway funding approaching \$30 million could be at stake, while a ban could be placed on new stationary sources emitting carbon monoxide.

C. Ecological Effects

No direct effects on ecosystems have been attributed to CO. However, sources that contribute carbon monoxide to the atmosphere (primarily motor vehicles) are also suspected contributors to more far-reaching global pollution problems that affect the earth's ecosystem.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception and Political Pressure

The CO problem in Denver has received much public and political attention and focus in recent years. The Better Air Campaign has heightened the public's awareness of the issue. In recent polls, over 80% of the public lists air pollution as a major problem confronting the metro area. In the political arena, Governor Romer has taken tough stances on strategies to combat the CO problem. Senators Armstrong and Wirth have been strong proponents of Congressional action to address CO problems in high-altitude cities like Denver. Mayor Pena has emerged as a spokesman for cities in the West with air pollution problems.

Despite the attention and efforts underway, voluntary efforts by citizens to reduce individual contributions of CO have not yet been totally successful. While many citizens comply with voluntary efforts, widespread awareness of the problem has not translated into sufficient individual action. Voluntary driving restrictions during the 1987-88 Better Air Campaign reduced vehicle miles travelled in the metro-area less than ten percent.

Some of the inaction may be explained by a perception problem with CO. Since CO is colorless and odorless, it is difficult for the public to visually comprehend the extent of the CO problem. In fact, the public often confuses or includes CO with the visible Brown Cloud.

B. Regulatory Status

1. Legal Requirements

Under authority of the Clean Air Act, EPA has established a health-based ambient standard for CO that has to be met in all areas of the country. In 1987, Denver exceeded the standard on greater than 20 days, with the highest ambient level around twice the standard.

Last year the Colorado Department of Health (CDH) and the Metropolitan Air Quality Council (MAQC) developed a draft implementation plan to meet the federal standard, although the plan failed to demonstrate attainment by the statutory deadline

of December 31, 1987. In the face of widespread non-attainment of the CO and ozone standards throughout the country and, lacking reauthorization of the Clean Air Act, a proposed EPA policy would require local areas not meeting the standard to achieve a 3% annual reduction in CO levels until the standard is achieved.

Congress is currently considering reauthorization and amendments of the Clean Air Act. The deadline for attaining standards was extended until August 31, 1988 in order to preclude imposition of sanctions against local areas until Congress can act. Many provisions are being considered that will have direct effects on CO control strategies in Denver.

The State of Colorado has adopted many regulatory programs to address the CO problem, most notably the inspection/maintenance program, the Better Air Campaign, woodburning bans on high pollution days, and the oxygenated fuels program. In the current session of the Legislature, several bills were considered that potentially could impact additional CO control strategies. None of these bills passed, although a scaled-down version of one bill remains under consideration.

2. Current Activities

Controlling CO emissions has been the focus of air pollution activities in the Denver area during the decade of the 1980's. The primary strategies include:

- o Federal Motor Vehicle Control Program, which automobile tailpipe standards and results in reduced emissions as older cars are retired.
- o Better Air Campaign that targets voluntary no-drive days during the high-pollution season to reduce vehicle miles travelled.
- o Woodburning bans in some local cities.
- o Strengthened automobile inspection/maintenance program.
- o Oxygenated fuels program during the high-pollution season, implemented January 1, 1988.

Projections indicate the Denver area will attain the CO standard sometime in the late 1990's with current control strategies. However, the gains will soon be eroded by projected increases in vehicle miles traveled unless further programs are put into place to reduce driving.

3. Public Expenditures

The CDH Air Pollution Control Division, the prime implementor of CO control strategies, has an overall FY-88 budget of nearly \$6.0 million, of which over \$1.4 million comes from an EPA grant. Nearly half of the APCD budget (\$2.8 million) is devoted to developing and implementing CO control strategies along the Front Range. EPA supplies over \$400,000 to this effort.

The annual budget for the MAQC approaches \$250,000 annually, of which nearly half goes towards CO control strategies.

C. Possibilities for Further Control

Improvements can obviously be made in all of the current control strategies. Congress is considering tightening emission standards for automobiles. High altitude and cold start requirements would also help. Many believe a centralized I/M program could result in additional in-use emission reductions. Greater use of ethanol as an oxygenated fuel could further reduce emissions. More extensive wood-burning restrictions are also under consideration.

While air quality benefits from these more stringent strategies could be significant, greater emission reductions can be generated from programs which further reduce driving and vehicle miles travelled. Transit improvements, mass transit, HOV lanes and more aggressive carpool programs are transportation strategies that are being considered, as well as further incentives to convince citizens to simply reduce their driving.

IV. WORK GROUP FINDINGS

The ESP Outdoor Air Work Group recognized carbon monoxide as a serious air quality problem facing the metro area. The Work Group did not dwell on health or economic effects from CO, nor on technical data gaps. Instead, the Work Group focused on implementation issues that are impeding attainment of the federal standard. While no attempt was made at the time to come to consensus on these issues and make specific recommendations, members generally supported the observations presented below.

The Work Group felt strongly that the metro area can no longer rely solely on voluntary efforts the citizenry to improve air quality. Economic and regulatory incentives and disincentives have to be applied, leading to behavioral and lifestyle changes that discourage driving and other individual activities that pollute. However, in order to modify behavior, the public has to have alternatives available. In this regard,

the Work Group advocated improving and expanding the mass transportation system throughout the metro area. In addition, greater public education efforts are needed in order to convince the public that changes in lifestyle are needed to achieve cleaner air.

While advocating reduced driving as a strategy that needs more emphasis, a majority of the Work Group also favored more stringent emission requirements for automobiles (such as high altitude testing and cold weather certification) and supported lobbying efforts on this issue at the national level.

Finally, the Work Group recognized the significant role local governments must play in implementing air pollution control strategies. Local governments need technical and implementation assistance so that they can effectively integrate air quality considerations into their local land use and transportation planning decisions.

FINE PARTICULATE MATTER

I. ISSUE DESCRIPTION

The term particulate matter refers to condensed liquids and solid particles suspended in our ambient air. The sources of particulate matter are numerous and include emissions from gas and diesel motor vehicles, power plants, industrial sources and wood stoves, as well as sand and dirt from roadways.

Several measurements of particulate matter are used depending on the size of the particles being measured. EPA's new ambient standard addresses PM-10, which is a measure of fine particulate matter less than 10 microns in size. This health-protective standard is based on evidence that it is these smaller particles which are primarily responsible for causing respiratory problems and exacerbating lung disease. The major portion of Denver's "Brown Cloud" results from fine particulate matter below 2.5 microns in size suspended in the air.

In addition to its suspected effects on human health, fine particulate matter has an adverse aesthetic impact, increases maintenance costs for buildings and equipment through soiling and materials damage, and may even be affecting economic growth in the metro area by discouraging business expansion and relocation.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

The best available scientific information from health effects studies conducted in other parts of the U.S. and Europe was used to estimate health effects caused by fine particulate matter in metro Denver. These studies give estimates of the number of cases of a given health effect as a function of pollution levels. Particulate levels in metro Denver during 1984, 1985, and 1986 were averaged to establish a baseline scenario from which reductions were assumed. Estimates of the annual number of cases prevented if the metro area were to meet the federal standard were then made.

o Information on Human Exposure

It is virtually impossible for an individual living in metro-Denver to avoid exposure to some level of ambient fine particulate matter on a daily basis. To estimate exposures to the population of the entire study area, data from the ten monitors operated in recent years were used to calculate a

pollution level for each census tract based on levels at the monitors nearest to each tract.

o Impact on Human Health

Studies have not yet demonstrated a direct link between high levels of fine particulates and premature mortality or other health effects. The studies do however show a statistically significant relationship between the two. Chronic obstructive pulmonary disease (COPD) is probably the most significant health effect associated with high ambient concentrations of fine particulates. Aggravation or worsening of this condition can lead to premature mortality, increased emergency room visits, and individual restricted activity days.

The analysis conducted for the ESP estimates that if the new standard for fine particulates was met, approximately 20 premature mortalities, 1,200 emergency room visits, and 180,000 individual restricted activity days might be avoided each year in the metro Denver area. These numbers can be thought of as the "best estimate" provided by the analysis. It is important to note that under a range of plausible assumptions the annual estimates of these health effects vary from between 0 and 114 premature mortalities, 100 and 8,300 emergency room visits, and between 255,000 and 1.5 million restricted activity days.

2. Other Health Issues/Limitations of the ESP Analysis

Applying the results of studies conducted in other places to a local situation like Denver requires use of the best estimate of the relationship between fine particulate matter and health effects found in these studies. Correlating these studies to Denver is complicated by such things as the variability in the chemical composition of fine particulate matter from place to place and the intensity of pollution insult. These factors, which could not be corrected for in our study, could change the expected effect of the pollution on human health in Denver.

Fine particulate matter is also a source of air toxics which are suspected carcinogens and can cause other serious health effects. Heavy metals and organics that attach to fine particulate matter are pollutants of concern that are undergoing much evaluation in the health community.

B. Economic/Welfare Effects

Much concern has been raised over the potential adverse economic impact resulting from Denver's Brown Cloud. The most direct impact on growth would come from a potential ban construction of new sources of air pollution and withholding of highway construction funds if Denver fails to meet EPA's air pollution standards. A more widespread concern, though, is the

postulated impact on economic growth because new businesses do not wish to locate in an area with such a visible air quality problem. The adverse publicity resulting from the Brown Cloud also damages the Denver area's national reputation. Several surveys of companies around the country have reported that Denver's air quality would negatively affect economic development and business location decisions, though air quality does not appear to be the overriding factor.

Fine particulate matter can also result in materials and soiling damage to residential, industrial, and commercial property. An analysis for the ESP indicated soiling damage in the Denver area could result in a \$100 million loss annually. In addition, fine particulate matter results in visibility degradation. Studies conducted in several U.S. cities indicate that households value the prevention of visibility degradation due to its aesthetic effects alone.

C. Ecological Effects

Many of the sources that contribute particulate matter to the atmosphere are possible contributors to more far-reaching global pollution problems that affect the earth's ecosystem. Man-made pollutants are suspected of affecting the earth's atmosphere, resulting in global warming.

Concern has also been raised by some scientists regarding the impact of Denver's air pollution on sensitive mountain lakes on the eastern side of the Continental Divide.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Because of the obvious nature of the problem (the visible Brown Cloud) and the perceived health effects on high pollution days, the public seems very aware of the issue. In recent polls, over 80% of the public listed air pollution as a major problem confronting the metro area. Government officials feel pressure from the citizenry to improve air quality. Governor Romer has recently been in the forefront of state action on the issue.

While public attention has been focused recently on CO control strategies, the citizenry has not yet been asked to do much regarding Brown Cloud strategies, other than wood burning. Much more individual action will be needed in the future to combat the problem.

B. Regulatory Status

1. Legal Requirements

EPA recently replaced the TSP (Total Suspended Particulates) ambient standard with a standard addressing fine particulate matter less than 10 microns in size (PM-10) in order to more accurately address suspected health concerns. The Metropolitan Air Quality Council (MAQC) and the Air Quality Control Commission (AQCC) must develop a State Implementation Plan (SIP) by April 1989 that will outline control strategies to meet the PM-10 standard. The State will be responsible for enforcing the regulations, which are likely to include local ordinances like wood-burning bans.

2. Current Activities

Most of the air pollution activity in recent years in the metro area has addressed carbon monoxide. In comparison, fine particulate matter control efforts have not been as aggressive and extensive. However, this is quickly changing as renewed emphasis is being placed upon PM control strategies as a result of concern over the Brown Cloud and the upcoming PM-10 requirements. While some strategies have been implemented (such as episodic wood-burning bans) extensive further action will be required to fully address fine particulate problems.

Development of control strategies for fine particulates (both PM-10 and Brown Cloud) awaits the results of research efforts being conducted by CDH, EPA and private sources. Of particular interest is a million dollar research study, funded primarily by private sources and coordinated by the Greater Denver Chamber of Commerce, that is looking at the contributions of sources to the Brown Cloud.

The Governor also appointed a blue-ribbon Diesel Task Force to make recommendations to address diesel vehicles, a major source of fine particulate matter in the metro area. The panel's highest priority recommendations were: diesel I/M, roadside opacity enforcement, idling ordinances, and heavy duty mass emissions laboratory.

Several air pollution bills were introduced during the current session of the Legislature. A bill requiring a diesel I/M program and diesel fuel standards recently passed.

3. Public Expenditures

The Colorado Department of Health has budgeted over \$800,000 for PM-10 control activities statewide in FY-88, of which nearly \$60,000 came from a grant from EPA. While the bulk of this money goes to Front Range areas, rural areas in the state also have a

PM-10 problem and are receiving state attention. The annual budget for the MAQC approaches \$250,000, of which greater than 50% goes for PM control activities.

C. Possibilities for Further Control

Concerted efforts to control sources of fine particulate matter are just beginning and are going to require tough choices throughout the metro area. Control strategies under consideration include:

- controls on diesel vehicles, including inspection/maintenance, fuel standards, and alternative fuels;
- further wood-burning bans and restrictions;
- controls on power plants and other industrial sources, including possible conversion from coal to natural gas;
- better methods of street sanding and street cleaning to reduce reentrained dust;
- transportation improvements, including mass transit, to reduce driving.

Most of these strategies are technically feasible, but the economic and political feasibility have yet to be fully assessed.

IV. WORK GROUP FINDINGS

The ESP Outdoor Air Work Group considered many aspects of the particulate matter issue in the Denver area. The Work Group discussed the PM benefits analysis conducted for the ESP, as well as other health and economic impact concerns associated with the problem. Members suggested specific changes to the ESP analysis, which were incorporated by staff in the final draft report.

The Work Group recognized the limitations of the ESP analysis and concluded that while more specific information on health and economic effects would be helpful, such information would be difficult and expensive to obtain. The existence of a health standard that will not be met in Denver and the concern of the business community are sufficient evidence to indicate that the problem should be addressed. The Work Group felt the focus of future activities should be solving the problem in the most cost/effective manner.

Many of the overall findings of the Work Group presented in the paper on carbon monoxide ultimately apply to fine particulate matter as well. Less reliance on solely voluntary efforts, reduced driving and individual polluting activities, and public

education are all necessary concerns for addressing cleanup of the Brown Cloud.

The Work Group discussed at length the considerable lack of technical understanding related to control strategies for the Brown Cloud. Many gaps currently exist in our knowledge and effective control strategies can not be developed without additional basic data.

Information on high altitude emission factors are still lacking, which will hinder assessments of the effectiveness of control strategies. Much uncertainty surrounds the contribution of street sanding and cleaning activities to the Brown Cloud and the effectiveness of various control options.

Many of the questions on source contribution are expected to be answered by the Denver Brown Cloud Study and other efforts underway by CDH and EPA.

OZONE

I. ISSUE DESCRIPTION

Ozone is a pollutant that forms in the atmosphere in the presence of hydrocarbons, nitrogen oxides, and sunlight. Sources of these ozone precursors include automobiles, power plants, and other sources of fossil fuel combustion. Ozone can impair lung functions in people with existing respiratory problems. People in good health may even be affected, experiencing effects such as chest pain and shortness of breath.

The Denver area will probably meet the federal ambient standard of .12 ppm for ozone some time this year. However, continued maintenance of the standard has not yet been demonstrated.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

For this analysis, 1986 ozone levels in the Denver metro area were used as the baseline from which benefits of reducing ozone concentrations were calculated. Health effects estimates are based on evidence from published epidemiological studies concerning human populations exposed to ozone. Information from these studies gives the number of cases of a given health effect as a function of the pollution level.

o Information on Human Exposure

Ozone exposures in the metro Denver area were estimated using data from the six ozone monitors operating in 1986. A pollution level for each census tract was calculated based on levels at the monitors nearest to each tract. This approach is the same as that which was used in the analysis of fine particulate matter.

o Impact on Human Health

Clinical studies in which subjects have been exposed to a known amount of ozone in a controlled setting have demonstrated that ozone is irritating to the nose and throat and causes temporary reductions in lung function. These effects have been found in adults with chronic respiratory conditions and in healthy children and adults. Quantitative relationships are difficult to identify from these types of studies, but the

findings support the epidemiological studies that have found a relationship between ambient ozone levels and occurrences of respiratory restricted activity days or asthma attacks.

The analysis conducted for the ESP estimates that if the ozone standard had been met in 1986, approximately 150 asthma attacks, 6,900 restricted activity days, and 15,400 cases of eye irritation might have been avoided.

These numbers should be thought of as the "best estimate" provided by the analysis. It is important to note that under a range of plausible assumptions the estimates could range from between 35 and 445 asthma attacks and between 5,900 and 7,900 restricted activity days if the standard were met.

2. Other Health Issues/Limitations of the ESP Analysis

The estimates of human health effects presented above are based on available information concerning the effects of ozone on public health. A great deal of uncertainty remains about much of the research on which these estimates are based. To address this uncertainty, upper and lower range estimates are presented when there is sufficient information in the literature to suggest a likely range. These are not intended as absolute bounds, but as ranges within which the actual damages are likely to fall.

There is some evidence that increased incidence of chronic respiratory illnesses may be associated with exposure to elevated levels of ozone, but there is considerable doubt about whether such an association has been adequately demonstrated. There is insufficient quantitative evidence available to estimate the potential magnitude of such effects.

B. Economic/Welfare Effects

Because of its chemically reactive nature, ozone may accelerate the aging of many materials, such as nylon, other synthetics, dyes, paints, and rubber products. A number of commercially important rubber-based products, including automobile tires, rubber seals, and pharmaceutical goods, are particularly sensitive to ozone damage.

Reduction in social welfare due to ozone pollution induced materials damage can be expressed in terms of increased costs to producers and consumers. These costs may be a result of accelerated replacement, and maintenance and repair costs, or of increased avoidance costs when industries use additives to avoid or minimize damage.

While not necessarily applicable to the Denver urban area, there is also evidence to indicate ozone can detrimentally affect the yield from agricultural cash crops.

C. Ecological Effects

Ozone can affect many forms of vegetation. In addition to the effects on cash crops, recent findings have led many scientists to believe that ozone is a major contributor to the decline in growth of many species of trees. Limited data suggests ozone pollution may have played a role in the loss of at least some forests in several areas of the continent.

Many of the sources that contribute ozone precursors to the atmosphere are suspected contributors to more far-reaching global pollution problems that affect the earth's ecosystem. Man-made pollutants are suspected of affecting the earth's atmosphere, resulting in global warming.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Since ozone pollution is not as significant a problem in Denver as carbon monoxide and fine particulates, the issue has not received widespread attention on the part of the public.

In many instances confusion exists in the minds of the public between stratospheric ozone and ozone pollution. Stratospheric ozone is the desirable layer that protects us from harmful solar rays and is suspected of being depleted by man-made chemicals.

B. Regulatory Status

1. Legal Requirements

The legal requirements for ozone under the Clean Air Act are similar to those for CO and fine particulates. EPA has established a health-based standard and the State has developed an implementation plan to meet the standard.

Based on recent data, the Denver area is very close to meeting the federal standard of .12 ppm. While the standard may be met this year, EPA will not consider the area attainment for ozone until the State can demonstrate maintenance of the standard for several years in the future.

2. Current Activities

Controlling sources that contribute to ozone formation focuses on controlling hydrocarbon emissions from automobiles and stationary sources. Colorado's inspection/maintenance program reduces hydrocarbon as well as CO emissions from gasoline-powered vehicles.

The State is required to regulate other sources of volatile organic compounds (VOCs) such as gas terminals, dry cleaners, and users of paints and solvents.

3. Public Expenditures

The CDH Air Pollution Control Division budgeted nearly \$725,000 for ozone attainment efforts in FY-88, primarily in the Denver area. EPA provided over \$115,000 of this amount in a grant to the State.

C. Possibilities for Further Control

As indicated, the State will have to demonstrate maintenance of the standard in the future. Continued reductions resulting from cleaner cars taking the place of older cars will be offset in part by increases in vehicle miles travelled throughout the metro area. Unlike CO and fine particulate matter, some of the highest levels of ozone in the metro area occur in the distant suburbs of Denver (such as the Highlands Ranch area).

Greater compliance with VOC regulations will also be required from stationary sources in order to maintain the standard.

EPA is also considering lowering the national ambient standard for ozone based on new evidence of health, welfare and ecological effects. If this occurs, further control efforts may be required in the future.

IV. WORK GROUP FINDINGS

The ESP Outdoor Air Work Group did not address ozone pollution since the group did not consider it to be as significant a problem as carbon monoxide and fine particulates.

AIR TOXICS

I. ISSUE DESCRIPTION

A number of air pollutants, which are commonly referred to as air toxics, have been identified as having the potential to cause cancer and other health problems when inhaled by humans. An analysis completed by EPA in May 1985 indicates that most of the cancer risks from air toxics are caused by metals, volatile organic compounds, and products of incomplete combustion (PIC).

In the EPA analysis, approximately fifteen pollutants or pollutant groups were identified as being responsible for most of the cancer risk from air toxics. These are chromium, cadmium, arsenic, benzene, carbon tetrachloride, chloroform, ethylene dibromide, ethylene oxide, formaldehyde, perchloroethylene, trichloroethylene, PIC, asbestos, radionuclides, and gasoline vapors.

Not surprisingly, an examination of emissions associated with these pollutants shows a diverse and complex group of sources including motor vehicles, power plants, industrial processes, wood burning, chemical and petroleum refining, solvent usage, dry cleaning facilities, and marketing of gasoline. The variety of pollutants and sources increases the difficulty of regulating this potential problem.

II. IMPACT ASSESSMENT FACTORS

B. Public Health Issues

1. Environmental Strategies Project Analysis

A major component of the ESP is a program to collect ambient air toxics data in the Denver metro-area and to assess the risks to the population from these pollutants. The monitoring program, which used state-of-the-art sampling and analysis techniques, collected data for the past year, concluding at the end of February. Analysis of this data is underway, though the risk assessment will not be completed until September 1988.

2. Other Public Health Issues

The May 1985 EPA study of the air toxics problem nationwide examined 45 air toxic compounds and concluded that exposure to these compounds may cause 1300 to 1700 cases of cancer each year. Large point sources were found to be responsible for the highest individual lifetime risks and up to 25% of the cancer incidence attributable to air toxics.

Individual risks associated with specific area sources were

generally found to be low in the EPA study. However, because these sources often are located in populated urban areas, they account for about 75% of the cancer incidence from air toxics. In addition, measurements of ambient concentrations of 10 to 15 air toxics in five large urban areas indicated that the air toxics "soup" in these cities may be responsible for additive individual lifetime risks of 1 in 1000 to 1 in 10,000.

Because of the high levels of carbon monoxide and particulate matter in the Denver area, it is suspected that Denver may also have an air toxics problem since air toxics come from many of the same sources. In addition, many compounds in particulate matter are considered toxic air pollutants.

B. Economic/Welfare Effects

Since air toxics pollution is still only an emerging issue in the Denver area, there has not been any discernible discussion of potential adverse economic and welfare effects locally. If air toxics are a significant problem in the Denver area, this will only add to the current image problem resulting from air pollution.

A potential welfare effect is decreased property values around point sources of air toxics. People generally do not want to live in areas surrounded by air toxics sources. This is probably not a widespread problem in the Denver area, but rather more of a localized problem around the few significant point sources in the area (such as around the Globeville smelter and sources in the Commerce City area).

C. Ecological Effects

Substantial uncertainty exists pertaining to the potential ecological effects of air toxics. Little data have been collected nationally, although EPA reports there is growing evidence of adverse regional impacts, such as in the Great Lakes region. No data have been collected in the Denver area.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Public awareness of air toxics issues in the metro area is growing, but still remains relatively low. Air toxics problems are generally associated with heavily industrialized areas with refineries, smelters and other point sources. Since Denver is not a heavily industrialized area, Denver's potential problem with areawide sources may not be widely recognized.

B. Regulatory Status

1. Legal Requirements

Under the Clean Air Act, EPA is required to establish standards for hazardous air pollutants (NESHAP). To date, eight pollutants have been listed under NESHAP: asbestos, beryllium, vinyl chloride, coke oven emissions, benzene, arsenic, radionuclides, and mercury. The Agency is currently evaluating a host of other chemicals for possible listing.

In June 1985 EPA issued its air toxics strategy to address the control of both routine and accidental releases of toxic air pollutants. In addition to using EPA's authority under the Clean Air Act to regulate chemicals and sources of national concern, the strategy also relies upon state and local control programs to control high risk sources of local concern that are not appropriate for federal regulation.

CDH is implementing the various components in its Air Toxics Multi-Year Development Plan to address the air toxics problem statewide. The plan outlines a program to enforce EPA's NESHAPs, control high risk point sources, assess high risk urban areas, and build the technical, regulatory, and administrative capabilities needed to implement an effective program.

2. Current Activities

CDH is still in the early stages of developing its air toxics program. Much of the effort is devoted to the collection of data in order to determine the extent of the areawide problem. Until these data are collected, control strategies aimed specifically at air toxics cannot be developed. The State is also building its basic program and targeting high risk point sources, such as the Globeville smelter.

EPA and CDH have embarked upon a comprehensive effort to gain more data on air toxics through the Denver Air Toxics Study. This study will characterize the extent of the air toxics problem in the metro area and provide information for the development of control strategies. Important parts of the study are:

- o Ambient air toxics monitoring, sponsored by the ESP, to provide data on ambient concentrations at four sites in the metro area;
- o Development of high-altitude emission factors for air toxics from woodburning sources and gasoline and diesel vehicles;
- o Inventory of air toxics and volatile organic emissions from stationary sources in the metro area;

- o Survey of woodburning practices in the metro area to aid in modeling air toxics and PM-10 concentrations;
- o Modeling of concentrations and source contributions of air toxics throughout the metro area based on data collected in earlier steps;
- o Assessment of health risks from air toxics in the metro area based on the modeling and monitoring efforts.

3. Public Expenditures

In FY-88, CDH budgeted nearly \$300,000 to continue developing its air toxics program. Over half of this amount comes from an EPA grant. In addition, EPA, through the Environmental Strategies Project and other special initiatives, has contributed over \$600,000 directly to the Denver Air Toxics Study over the past two years.

C. Possibilities for Further Control

Many sources of air toxics are currently being regulated by existing programs addressing other pollutants: CO, PM, and VOCs. Further control efforts may be needed if specific air toxics concerns are not being adequately addressed by current programs. However, this will not be known until the extent of the air toxics issue is further defined.

IV. WORK GROUP FINDINGS

The ESP Outdoor Air Work Group did not specifically address air toxics issues. After a briefing on the Denver Air Toxics Study, the Work Group delayed further discussion pending results from the ongoing data collection and analysis efforts.

C. WATER QUALITY

1. Drinking Water Quality
2. Groundwater Quality
3. Surface Water Quality

STAFF CONTACT:

Patrick Cummins	293-1621
Paula Machlin	293-1893

DRINKING WATER QUALITY

I. ISSUE DESCRIPTION

Consumption of contaminated drinking water poses a threat to human health. While public water supplies are required to comply with federal and state regulations designed to be protective of human health, monitoring is not required for all possible contaminants. Contaminants may also reach people's taps when treatment processes malfunction.

Public water supplies in metro Denver are believed to provide a very high quality product, although there have been some widely publicized cases of contamination.

II. IMPACT ASSESSMENT FACTORS

A. PUBLIC HEALTH ISSUES

1. Environmental Strategies Project Analysis

o Analytical Approach

The drinking water risk assessment conducted by the ESP used recent data from four local public water supplies (Denver, Thornton, Arvada, and South Adams County) to estimate risk to human health.

EPA-approved information on carcinogenic potency was used to calculate the risk of contracting cancer from exposure to contaminants detected in the four systems.

Levels of non-carcinogenic contaminants were compared to EPA-approved "acceptable levels" to examine their potential for posing a threat to human health.

In addition to using the information supplied by these four systems, additional monitoring data were collected from two studies previously conducted on Denver area water supplies in order to estimate the upper bound risks from drinking water. A worst case water sample was constructed by assuming that contaminants were present at the highest measured levels reported in the data from the four systems or in the other studies.

o Information on Human Exposure

Approximately 75% of the metro Denver study area is served by the systems examined in the ESP analysis. Risks for the remaining 25% of the population were estimated based on the information from the four systems studied.

Human intake was calculated using the standard EPA assumption that the average adult drinks 2 liters of water per day for seventy years, and weighs 70 kilograms.

o Impact on Human Health

The ESP risk assessment calculated both cancer and non-cancer risk for the population of metro Denver. Carcinogenic risk was calculated for only those contaminants which have an EPA established carcinogenic potency factor.

The lower bound on carcinogenic risk was estimated using only those contaminants that were reported in the data supplied by the four systems. Arsenic was excluded from the lower bound estimate because of uncertainty regarding its potency.

The lower bound estimate of carcinogenic risk suggests that less than one excess cancer cases can be expected in the metro area every five years from exposure to carcinogens in drinking water.

The upper bound estimate of carcinogenic risk suggests that approximately 10 excess cancer cases can be expected in the metro area every year.

No non-cancer health effects are expected to occur from exposure to contaminants in drinking water at the levels found in this analysis. The issue of lead in tap water is discussed separately.

2. Other Health Issues/Limitations of the ESP Analysis

Limitations of the ESP analysis exist at two levels. First, it is important to note that not all public water supplies in the study area were examined in this analysis.

Also, data provided by the systems studied do not include information on all possible contaminants.

In some cases, there was data available on contaminant concentrations, but no EPA-approved information on human health effects.

Finally, there was no analysis of private wells or very small supply systems. Because many of these supplies rely on untreated ground water, there is the possibility that contamination problems unlike those in the larger systems may exist.

B. Economic/Welfare Effects

In South Adams County, a \$17 million water treatment

facility was recently built to correct a ground water contamination problem. This case points out the potential for large economic and welfare costs for correcting contaminated drinking water supplies.

More stringent monitoring and treatment requirements under the 1986 Amendments to the Safe Drinking Water Act may mean that public water supplies will be spending more money in the near future to upgrade water treatment facilities. These increased costs will be passed on to customers.

Other economic effects include costs to individual homeowners who pay for replacement of home plumbing that is affected by corrosive water supplies.

C. Ecological Effects

Ecosystems may be impacted by purification plant discharges to streams or from land application of sludges.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Publicity surrounding drinking water contamination problems in the metro area has raised the public's awareness of the potential for problems with drinking water supplies.

Most of the political pressure that has been brought to bear on this issue is the result of efforts on the part of the limited number of people directly affected by particular problems with drinking water supplies.

B. Regulatory Status

1. Legal Requirements

Public drinking water supplies are defined as those systems which serve 25 or more people for at least 60 days per year. Every public water supply in the country must comply with EPA's Primary Drinking Water Regulations which currently set standards for 33 contaminants.

The 1986 Amendments to the Safe Drinking Water Act (SDWA) require EPA to set standards for 50 more contaminants by June 1989, for another 25 by January 1991, and for 25 more every three years thereafter.

EPA has delegated Primary Enforcement authority to the State of Colorado for regulations under the SDWA. EPA gives the state an annual grant to carry out this responsibility.

2. Current Activities

The 1986 Amendments to the SDWA contain requirements for more extensive treatment and monitoring of public water supplies.

A Safe Drinking Water Bill was introduced in the Colorado Legislature this year. The bill would allow the State to set standards for contaminants which the federal government does not regulate, and would allow the State to take legal action against polluters.

EPA Region VIII has identified four priority contaminants for further attention in the near future. These four are the contaminants produced as by-products of the disinfection process (trihalomethanes), microbiological contamination in small systems, radionuclides, and lead that results from in-home plumbing fixtures.

3. Public Expenditures

EPA's grant to the State in FY88 to carry out their responsibilities as primary enforcers of the SDWA was approximately \$425,000. EPA Region VIII has a state project officer who maintains oversight of the designated program.

The State of Colorado has 6 FTEs in the Drinking Water Program at the CDH. This staff is supported by field engineers, laboratory technicians, and an epidemiologist.

County health departments also conduct inspections of public water supplies within their jurisdictions.

C. Possibilities for Further Control

All public water supply systems will be required to monitor for a greater number of contaminants as new standards are set. These increased monitoring efforts will decrease the possibility of harmful contaminants going undetected.

Based on monitoring results, additional treatment processes may have to be employed to meet the new standards.

IV. WORK GROUP FINDINGS

The ESP Drinking Water Work Group concluded that:

- o Data from the four systems analyzed suggests that municipal drinking water supplies in metro Denver provide a very high quality product which poses low risk to human health;

- o The 1986 Amendments to the Safe Drinking Water Act are intended to effectively address most of the outstanding concerns about municipal drinking water supplies;
- o Drinking water being consumed from private wells or small systems is of concern because it is unregulated, untreated, and because little is known about the actual use of these sources in the metro area;
- o In order to fully assess the risks from drinking water in the metro area, additional data on the presence of contaminants and their effects on human health are needed.

GROUND WATER QUALITY

I. ISSUE DESCRIPTION

Contamination of ground water by industrial, agricultural, and urban sources diminishes the value of the resource for future use and may threaten human health if the water is used for drinking, cooking, or bathing.

While use of ground water in metro Denver is limited relative to the use of surface water, ground water is utilized by individual homeowners, small water districts, and as a supplemental source by large municipal systems in the area.

In general, wells that draw from shallow alluvial aquifers are at greater risk than those that draw from deep, confined aquifers because the shallow aquifers are more easily contaminated. Deep, confined aquifers may also be at risk from poorly constructed or abandoned wells which can provide direct conduits for contaminants.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

The Environmental Strategies Project did not conduct specific analysis of the human health risks or economic impacts from ground water contamination.

A limited number of ground water wells were examined as part of the analysis of public drinking water supplies. The ESP analysis of hazardous waste issues examined some of the potential threat to human health from hazardous waste contaminating ground water. However, the drinking water analysis did not examine threats to ground water from sources such as agricultural contamination from application of fertilizers or pesticides, petroleum spills or leaks from underground storage tanks, or nitrate contamination by septic systems.

B. Economic/Welfare Effects

When ground water is being used as a drinking water source, expensive treatment techniques may have to be employed to purify the water. In South Adams County, a \$17 million dollar water treatment facility was built to correct a ground water contamination problem.

Ground water contamination at local Superfund sites will cost the government and private parties millions of dollars to remediate.

Ground water can also be valued as a future resource. Clean ground water will be an important source of drinking water in the event of a prolonged drought which diminishes surface water supplies, or if growth in the area increases water demand beyond current capacity.

C. Ecological Effects

Most sources of ground water contamination also contaminate soils. This may lead to contaminants entering the food chain and disruption of fragile ecosystems.

Contaminated ground water that discharge to surfaces water bodies has the potential to adversely impact plant and animal life dependent on the water.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Publicity surrounding contamination of ground water serving as drinking water sources in the metro area, and publicity surrounding problems at area Superfund sites, has heightened public awareness of this issue.

Concern over ground water contamination by both industrial and agricultural sources has prompted several states and the U.S. Congress to begin examining ground water protection legislation.

B. Regulatory Status

1. Legal Requirements

Regulations promulgated under authority of the various federal hazardous waste laws, primarily the Resource Conservation and Recovery Act (RCRA) and Superfund, have instituted stringent standards for the protection and cleanup of ground water at hazardous waste treatment, storage and disposal sites.

The Underground Injection Control Program that is part of the Safe Drinking Water Act (SDWA) requires a permit for injection of material through a well. This is designed as a measure to control ground water contamination.

Ground Water used for drinking water by a public water supply must comply with regulations under the SDWA.

The SDWA Amendments of 1986 also established a Wellhead Protection Program whereby states are required to develop protection programs by 1989. Colorado is not currently

implementing this program due to a lack of funding.

In May 1984, the Colorado Water Quality Control Commission adopted a Ground Water Protection Program which sets standards for ground water quality in five different use categories. To date, no ground waters in the State have been classified under this program.

It is the responsibility of the State Engineer's Office to issue permits for the use of ground water in Colorado.

2. Current Activities

Senator David Durenberger (R-MN) recently introduced the Ground Water Protection Act of 1988. The bill would provide a comprehensive strategy for protection of the nation's ground water and would be financed through a hazardous waste disposal tax, a solid waste disposal tax, a water supply assessment, and an excise tax on non-agricultural pesticides sold in the lawn and garden market. Several other ground water protection bills have been introduced in this session of the U.S. Congress.

The Colorado Department of Health is in the process of adding additional organic chemicals to those currently included in its classification system.

The State Engineer's Office is developing new regulations for well construction which will be more protective of ground water.

3. Public Expenditures

The Ground Water Branch in the Water Management Division of EPA Region VIII has 5 FTE working on ground water issues in the six state region. The Ground Water Branch has approximately \$25,000 in contract dollars annually.

The Colorado Department of Health has 5 FTE devoted to ground water issues, and received a grant of approximately \$90,000 in FY88 from EPA.

C. Possibilities for Further Control

Although preventing degradation of ground water quality is receiving increased attention at the national, state, and local level, to date nearly all efforts have been directed toward remediating ground water contamination. Remediation has proven to be very expensive, and therefore preventing future contamination is important for minimizing economic impacts.

National hazardous waste laws have stringent standards for protection and cleanup of ground water, but other potential

sources are not as well regulated.

Ground water contamination from agricultural use of pesticides is a suspected problem receiving increased attention in rural areas. Changing methods of application and exploring ways to reduce the need for pesticides are being examined.

IV. WORK GROUP FINDINGS

The ESP did not convene a work group to examine the ground water issue.

The Drinking Water Work Group captured some issues related to ground water and concluded that drinking water being consumed from private wells and small systems is of concern because it is unregulated, untreated, and because little is known about the actual use of these sources in the metro area.

SURFACE WATER QUALITY

I. ISSUE DESCRIPTION

Surface water bodies in the metro area serve a variety of purposes: irrigation, drinking water, recreation, and wildlife support. The waterways are also managed for flood control.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

Surface water quality potentially affects human health when used as drinking water for contact sports, or when contaminated fish or shellfish are consumed. However, the ESP considered drinking water health issues separately, and available data do not suggest that the remaining potential human health effects are significant at present. Consequently, for analytic purposes, the surface water issue was defined only in terms of the economic value of recreation.

B. Economic/Welfare Effects

1. Environmental Strategies Project Analysis

The ESP conducted a study of the value of recreation improvements which could occur with certain water quality improvements at five sites: Clear Creek above Golden, Sloan Lake, Segment 15 of the South Platte River, Adams County Gravel Pits, and Cherry Creek Reservoir. (Cherry Creek estimates were from another study.)

o Analytical Approach

For each site, a water quality change was postulated. For Clear Creek, Segment 15 and the Adams County Gravel Pits, the water quality changes were improvements. For the remaining sites, the water quality change was in terms of prevention of degradation. Then, the magnitude of changes in recreational activity that might occur based on the proposed water quality change was estimated. Three types of recreation activity changes were considered: 1) changes in participation in existing activities; 2) changes in quality of existing activities; and 3) addition of new activities. A dollar value was assigned to the changes in recreation activity based on data from other studies and the ESP economic consultant's professional judgement.

o Results

The results are a range of values for each site, and a range for the summation of the five sites. The range reflects

uncertainties in the available data. For individual sites, the annual value of changes in recreation activity based on the postulated water quality change range from \$300,000 to \$3 million in 1986 dollars; the five-site summation ranges from \$4.2 to \$8.5 million dollars.

2. Other Economic Issues/Limitations of the ESP Analysis

The estimates presented in the ESP analysis represent a lower regional bound. An upper bound was not estimated since a limited number of sites were examined and secondary economic values were excluded. We emphasize that these values are not that of the resource itself, but only of the specified recreation improvements.

Other possible economic effects which were not studied in the ESP include those that could occur: if an industry's decision to locate in the area is influenced by water quality and associated requirements; when waterways are well-developed amenities that attract new business; when adjacent property values are affected due to the influence of the waterway's quality on development potential. In addition, costs may be incurred by industrial, agricultural, or municipal users for cleaning up surface water to meet their needs or to meet applicable requirements.

C. Ecological Effects

Ecological effects were not studied in the ESP analysis. However, most water quality issues addressed through the existing regulatory process to date relate to protection of aquatic life.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

The public probably perceives that water quality issues are not as significant as, for example, air quality issues. Nevertheless, interest groups become actively involved and debate can be heated during regulatory activities.

Some public concern is shown by the fact that the recent bond issue to upgrade Denver Metro Central was overwhelmingly approved (although voter turnout was small). In addition, anecdotal information suggests that primary contact users are aware of water quality problems affecting recreation experiences.

B. Regulatory Status

1. Legal Requirements

The primary legal authority for protection of surface water quality is the 1987 Clean Water Act. The objective of the Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Colorado Water Quality Control Act is the parallel state law. The State Legislature is currently considering revisions in response to the 1987 federal amendments.

The Colorado Water Quality Control Commission of the Colorado Department of Health implements the key regulatory programs mandated by the Act. Through the National Pollutant Discharge Elimination System (NPDES) Permitting Program, the State issues permits to point sources which limit concentrations of specified pollutants as necessary to meet water quality standards (promulgated by the Water Quality Control Commission) and minimum technology-based requirements. Industries that discharge into municipal wastewater treatment facilities are required to remove certain toxics prior to discharge. Permits are enforced by the State with EPA oversight.

The EPA provides oversight, technical and administrative assistance, and funding to state and local agencies. The Denver Regional Council of Governments plans and coordinates local government efforts.

The other public and private entities which affect the river's use and the degree to which the potential benefits of water quality are realized include: the Urban Drainage and Flood Control District, the U.S. Army Corps of Engineers, the Colorado Division of Wildlife, the non-profit Greenway foundations, several city agencies within the metro-area, irrigators, sewage districts, and other dischargers.

2. Current Activities

Examples of significant current activities include permit conditions that require upgrading the Metro Denver Central Sewage Plant, and the Commission's triennial review of regulations establishing the South Platte Basin Use Designations and associated Water Quality Standards to be completed by spring.

New programs to control point sources established by the 1987 revisions to the Act require States to develop permit programs for stormwater discharge as well as to improve control of toxic point source dischargers. The 1987 revisions also intensify efforts to control nonpoint sources (NPS's) by requiring States to develop a NPS Assessment Report and a Management Plan. Section 319 provides implementation funds which have not yet been appropriated by Congress.

Although NPS control (the authority for which typically rests at the local level) has not been mandated in the past, the

law has directed the State and DRCOG to prepare basin plans and updates of the 208 Areawide Plan which focus on NPS's. In some areas, DRCOG and the various local governments have exceeded the requirements of state and federal law in these efforts. In response to the 1987 revisions, the State is initiating a statewide NPS Assessment. Exploration of the relationship between point and NPS's will take several years of substantial effort.

Sub-basin plans have been prepared for Cherry Creek Reservoir and Chatfield Reservoir which emphasize phosphorus control. In Cherry Creek Reservoir, an innovative control approach has been adapted from the "bubble concept" originally developed for Lake Dillon which enables point source dischargers to modify their allowable point source discharge based on clean up of NPS's. Local entities in some basins have adopted control measures such as best management plans for erosion control during subdivision construction, and/or considered measures such as subdivision siting controls, retention/detention, and load allocations.

Under DRCOG's direction, major special studies are under way for Bear Creek Reservoir and for Segment 15 of the South Platte and the lower reach of Big Dry Creek. Through the Commission's triennial review of water quality standards, Barr Lake and Standley Lake have surfaced as potential major issues.

Several significant projects are taking place outside the water quality regulatory framework. The Denver City Council spearheaded a special effort to improve water quality in several park lakes by dredging two lakes. In addition, various city agencies and nonprofit organizations have ongoing projects to develop parks and commercial activities around key waterways.

3. Public Expenditures

The Annual Workplan for 1987-88 for the Water Quality Control Division of Colorado Department of Health shows total state-wide funding of more than \$3.5 million for water quality management activities. The EPA provided nearly \$2 million to the State in FY 88 for state wide water quality efforts. On the order of 50% to 75% of these funds is expected to be directed towards the metro-area.

DRCOG expenditures were approximately \$210,000 which includes \$50,000 from EPA, \$25,000 from DRCOG itself, \$35,000 from donors such as Denver Metro, and about \$100,000 in local funds for special basin studies.

Voters recently approved a \$97 million dollar bond issue to upgrade metro Denver's waste water treatment plant.

Various private organizations and governmental entities contribute undetermined amounts to water quality management and development of waterways in general.

C. Possibilities for Further Control

Efforts are underway to improve understanding and control of NPS's as well as toxics. Opportunities may also exist to improve the overall value of our waterways by encouraging the various management entities to work together.

IV. WORK GROUP FINDINGS

The ESP Work Group concluded that surface water is a valuable resource affecting the quality of life for metro-Denver and downstream users. Ongoing programs and regulations have been effective in protecting water quality and significant progress has been made through the years. Nevertheless, continued development of tools and innovative approaches needed to both protect water quality and to maximize the value of the surface water resource as a whole are needed.

Specifically, the Work Group noted that surface water is managed by a number of agencies, each of which focuses on a selected parameter (e.g. flood control, water quality, wildlife, recreation, etc.). No single entity is responsible for developing overall goals to maximize the value of our urban waterways by integrating these separate but related activities. Consequently, opportunities to develop the full biological, recreational, and visual potential of surface water have not been fully explored. The Work Group suggested that a conference be planned where key actors could share information and develop goals and mechanisms for improving surface water management.

In addition, the Work Group found that actions to encourage habitat improvements such as innovative approaches to NPDES permits and wetlands protection are potentially valuable.

Several data gaps were also identified: need for an improved metro-area Lake Dynamics Model for standard-setting purposes; need for data on NPS's, including information such as water quality data on urban runoff "streams" such as Harvard Gulch.

D. SOLID AND HAZARDOUS WASTE

1. Emergency Response/SARA Title III
2. Superfund Sites
3. Underground Storage Tanks
4. Active Municipal Landfills
5. Inactive Municipal Landfills
6. Hazardous Waste Generators
7. Transportation of Hazardous Materials
8. Hazardous Waste Treatment, Storage and Disposal Facilities

STAFF CONTACT:

Debbie Welles 293-1454
Doug Linkhart 294-7018

EMERGENCY PLANNING AND RESPONSE/SARA TITLE III

I. ISSUE DESCRIPTION

Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), also known as the Emergency Planning and Community Right-to-Know Act, was created in response to several problems. First, communities have become interested in knowing what hazardous materials are being stored or transported through their neighborhoods. Second, in order to be prepared to respond safely and responsibly to a hazardous material incident, emergency response teams need to know what materials are being stored in their district, where, by whom, and in what quantities.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analyses

Due to the difficulty in locating usable data on the acute effects of accidental releases, the ESP did not attempt to evaluate this type of risk.

2. Other Health Issues/Limitations of the ESP Analysis

An important concern associated with emergency planning and response is to avoid (or lessen) potential acute health effects from a release. An acute effect is one which occurs immediately after exposure to a harmful substance. Such an effect may either be reversible such as a headache, or irreversible as in permanent lung damage.

B. Economic/Welfare Effects

If local governments do not know what hazardous materials are being stored at a plant it is very difficult to encourage facilities to develop their own emergency response plans. In the event of a spill, a lack of this type of information can put the emergency response authority in the position of having to respond without the benefit of background information on the types and quantities of substances they are likely to encounter. Risk to the responder and to the community has both a dollar value and a quality of life concern attached.

In the event that a facility or transporter experiences a significant release, the community is likely to incur damages to property and materials.

C. Ecological Effects

The longer it takes to clean up a release, the greater the

opportunity the substance has to permeate various environmental systems. Depending on the nature of the substance released, combined with a host of additional factors, e.g., weather, quantity released, media through which substance is traveling, etc., varying degrees of environmental damage may occur.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Occasional releases of toxic gases in other locations, such as Bhopal, India, have sensitized people to the need for emergency preparedness and efficient response programs.

B. Regulatory Status

1. Legal Requirements

- a. Title III of the Superfund Amendments and Reauthorization Act requires state, local governments, citizens and industry to cooperate in planning and assessing local emergency response capabilities.
- b. Facilities handling threshold quantities of certain chemicals are required to report such information to the State Emergency Planning Commission (managed by CDH), their local fire department and the local SARA Title III planning committee.
- c. In the event of a hazardous substance release, the law requires a facility or transporter to provide information to federal, state and local governments, and to the public concerning the hazards associated with such an incident.

2. Current Activities

To date, the Local Emergency Planning Committees have been attempting to determine how they will comply with the complexities of SARA Title III. Because they have received no direct funds from either the State or EPA, compliance has been inconsistent. Existing compliance strategies are localized and highly dependent on the interests of the individuals involved. It is important to reiterate that it is the responsibility of business and industry to provide the information requested in SARA Title III to the local committees, who in turn are responsible for managing this information and making it available to the public.

3. Public Expenditures

As of March 1988 EPA Region VIII has less than 1.5 FTE working

on the SARA Title III program in Colorado. The Region has no contract dollars to spend on SARA Title III.

The State of Colorado has no budgeted FTE and no contract dollars to expend on SARA Title III.

Most local governments argue that without implementation dollars from somewhere they will have trouble fully operating this program. On the other hand, some communities are using fire department and hazardous waste emergency response dollars to incorporate Title III requirements as a way of organizing information and database systems.

C. Possibilities for Further Control

A practical drawback related to SARA Title III is the fact that the law creates a costly information management problem. To date, Congress has provided no funding mechanism to assist in the implementation of this task. The problems that SARA Title III is designed to mitigate can be controlled as long as the act is complied with and control mechanisms are in place. In order for this to occur, the program will need funding.

If at some future date, communities have readily accessible data bases containing the kind of information required under SARA Title III, and if they are well trained in the upkeep and appropriate use of these data, it is hoped that prevention as well as emergency response will be more effective and that risks will be reduced.

IV. WORK GROUP FINDINGS

The Hazardous Waste/Materials Work Group felt strongly that acute risks need to be addressed in addition to longer term problems such as municipal landfills in order to understand overall health risk in the metro Denver area. Regardless of the fact that the SARA Title III information is mandated by law, the work group found that this information is and will continue to be difficult to collect and cumbersome to manage. In reality, most communities are still trying to understand what institutions should be reporting and need assistance with this basic task.

The suggestion was made to single out a community in the metro area which has the most advanced approach to managing the requirements of SARA Title III, and to help it completely develop and test a prototype database which could in turn be used by other metro area counties. The work group recognized that there have been other efforts around the country to develop such databases and believe that the metro area should be aware of these as it strives to develop its own.

Any effort on the part of the ESP should be coordinated with

the Colorado Department of Health (as well as other potential users) as they also need access to this information and are in a good position to recommend how to make it fit multiple needs.

SUPERFUND SITES

I. ISSUE DESCRIPTION

As of March 1988, there are six Superfund sites in metro Denver which have been placed on the National Priorities List and which require remedial actions to address existing or potential risks to human health or the environment. These sites are listed below.

Broderick Wood Products
Denver Radium
Lowry Landfill
Rocky Mountain Arsenal (Excluding Basin F)
Sand Creek Industrial
Woodbury Chemical

Three additional sites are proposed for inclusion on the National Priorities List and are currently being assessed as part of the Superfund program. These are:

Martin Marietta
Rocky Flats
Rocky Mountain Arsenal, Basin F

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

Three sources of information were used to characterize the range of potential risks: 1) exposure levels and risk estimates described in public documents, 2) the judgement of local officials familiar with the sites, and 3) national estimates of the number of people who might be exposed to releases at Superfund sites.

The conclusions relied primarily on worst case scenarios and assume that no remedial actions have been, or will be taken. While many of the worst case scenarios are unlikely to occur, they were developed to allow comparison of Superfund risks to other ESP issues also assessed under worst case conditions.

Health risks related to the Rocky Mountain Arsenal and Rocky Flats were not assessed to the same level of detail as the others because of their high level of complexity. Risks associated with these sites are uncertain and are undergoing evaluation through other efforts by EPA, CDH, and responsible parties.

o Information on Human Exposure

Analysis of metro Denver Superfund sites (not including Rocky Mountain Arsenal or Rocky Flats) suggests that worst case exposure conditions at the Denver radium sites represent individual risks that are unlikely to be exceeded at any of the other sites in the analysis, assuming no remedial action is taken. Individual risks for the more likely scenarios were based on a review of published information on the sites, and local judgments about the most likely exposure pathways.

Upper-bound estimates of the total number of adverse health effects (i.e., population risks) were developed by assuming worst case conditions at Denver Radium. The lower end of the range is based on national exposure estimates.

o Impact on Human Health

Under worst case conditions, individuals breathing radon stored in the soil and building materials at the Denver Radium sites over their entire lifetime could experience a 1 in 10 increased risk of developing lung cancer.

Assuming development of the Denver Radium sites without remedial action, this high individual risk translates into approximately three additional lung cancer cases per year. Current conditions at the Denver Radium Sites do not lead to risks nearly this high because they are not developed to the extent assumed under the worst case scenario. Worst case risks at other sites could be as high as those at the Denver Radium sites under similar assumptions about worst case exposures.

The other Superfund sites are unlikely to generate individual risks that exceed the risks associated with worst case conditions at Denver Radium. At some sites the risks would most likely be significantly lower. In fact, sites with limited access or with a low potential for off-site contaminant migration may well pose minimal health risks.

2. Other Health Issues/Limitations of the ESP Analysis

The very wide range of predicted risks for metro-Denver Superfund sites indicates that there may be substantial variation in potential health risks among sites. Although it is not possible for this study to provide precise estimates of risks at individual Superfund sites until completion of more detailed analyses of the sites, we believe it is unlikely that either individual or population risks will be found to greatly exceed the estimates provided in this analysis.

As indicated earlier, the Rocky Mountain Arsenal and Rocky Flats are major sites that are undergoing considerable assessment. While actual risks at these sites are not yet known, they are of particular concern on the part of EPA, CDH, responsible parties, and the general public.

In reviewing the Superfund risk estimates, the reader should note that the analysis only provided estimates for chronic health risks at Superfund sites. There is concern about potential acute health effects, especially to on-site workers (e.g., at Rocky Flats), but no quantitative estimates of these risks were available for the Environmental Strategies Project analysis.

B. Economic/Welfare Effects

Economic effects of the Superfund sites include opportunity costs of land which can not be used for other purposes; devaluation of land near the Superfund sites, and replacement cost of groundwater contaminated by the sites. In addition, national attention given to some of these sites has damaged metro Denver's image as a healthy place to live.

C. Ecological Effects

Pollution from Superfund sites may well have negative environmental impacts on one or more of the following: groundwater, surface water, air, soil, wetlands, plants, and/or wildlife. Contamination of groundwater and soil has been found at most of the sites, while testing continues on air pollution impacts.

Some analyses indicate that damage to habitats of unique and highly valued wildlife species may be of particular concern at the Rocky Mountain Arsenal.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Public awareness of environmental problems connected with many of the Denver area Superfund sites is high. Potential hazards from the Rocky Mountain Arsenal, Lowry Landfill, Martin Marietta, and Rocky Flats are widely recognized problems, while the remaining sites have less widespread visibility.

Pressure to clean metro Denver's Superfund sites focuses on potential health effects as well as the opportunity to use land at or near these sites for other purposes.

B. Regulatory Status

1. Legal

- a. Superfund regulations are derived from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).
- b. Superfund sites are included on the National Priorities List (NPL) on the basis of quantity and type of hazardous wastes present, pathway, and magnitude of affected populations.
- c. Once Superfund sites are identified, a remedial investigation and feasibility study (RI/FS) is performed to determine the degree of migration of wastes from the site and impacts on human health. This activity is underway for nearly all of the Denver area Superfund sites.
- d. EPA is required in CERCLA Section 121 to give preference to remedial actions which reduce the volume and toxicity of hazardous wastes on-site, minimizing the need for transportation or long term storage.
- e. The State of Colorado has a statute authorizing the Colorado Department of Health (CDH) to take part in Superfund cleanup efforts. In 1988, the State Legislature enacted a law extending this authority.

2. Current Activities

Governor Roy Romer has appointed a special task force of public officials and citizens to provide advice regarding cleanup of hazardous wastes at Rocky Flats.

3. Public Expenditures

Superfund expenditures are cited according to the FY 1988 SCAP (Superfund Comprehensive Accomplishments Plan of 8/24/87), a planning document which describes Fund Financed Projects. Fund financed refers to sites on which the clean-up is funded by Superfund when no potentially responsible party (PRP) can be found, or when a PRP litigates and payment is delayed.

The FY 1988 SCAP indicates that for FY 1988, EPA planned to budget \$12,496,910 for the eight Superfund sites in the metro area. This amount covers remedial investigations and cleanup for EPA and EPA contractors for the eight Superfund sites.

Also referencing the SCAP, EPA planned to transfer \$185,000 to the State of Colorado via a cooperative agreement for management assistance for FY 1988. Other non site-specific funds budgeted to CDH by EPA included \$200,000 for preliminary assessments and site investigations statewide and \$250,000 for core program development.

In addition to funds transferred to the state from EPA for the eight referenced sites, CDH budgeted \$36,200 for personnel and \$12,800 for operating costs. In addition, CDH budgeted an additional \$187,000 under CERCLA for the Rocky Mountain Arsenal.

The Department of Defense (DOD) and Department of Energy (DOE) have also budgeted funds for remedial investigations and cleanup at the Rocky Mountain Arsenal and Rocky Flats. For FY 1988, DOD budgeted approximately \$80 million for Rocky Mountain Arsenal Superfund activities. DOE has budgeted approximately \$30 million during FY 1988 for Rocky Flats cleanup activities.

The EPA, state, and federal budget numbers do not include legal e.g. litigation/ enforcement support costs. It should also be noted that the money spent on Superfund sites may be partially or fully recovered from potentially responsible parties. In the case of the Rocky Mountain Arsenal, Shell Oil has already agreed to repay a large portion of the cleanup costs.

C. Possibilities for Further Control

Further control options for each site are being very carefully reviewed and developed under the remedial investigation/feasibility study process.

IV. WORK GROUP FINDINGS

Given the current level of regulatory attention being given to Superfund sites, the work group decided to focus its attention on other environmental problems.

UNDERGROUND STORAGE TANKS

I. ISSUE DESCRIPTION

The Colorado Department of Health estimates that there are approximately 25,000 underground storage tanks (USTs) in Colorado. Roughly 7,500 of these USTs are located in the six county metropolitan Denver area.

Of the total number of USTs nationwide, EPA estimates that 5-20% may be leaking. Applying this national factor to the estimated 7,500 USTs in metro Denver, EPA estimates that between 375 to 1,500 USTs may be leaking in the metro area.

Most underground storage tanks contain petroleum products e.g., gasoline, diesel fuel, heating oil, and jet fuel. It is estimated that 1% of the USTs in Colorado contain chemical substances which have been defined as hazardous by EPA. Potential hazards from both types of USTs include leakage into groundwater or sewer lines, fires and explosions.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

Health risks were calculated by estimating the risks from a 1977 underground storage tank leak at a gas station in Northglenn. This estimate was then used to determine the potential risks associated with all metro-Denver USTs.

The leaking UST in Northglenn was selected because: 1) the amount of material that leaked from the site represents an upper-bound on the size of expected future leaks; 2) leaks from gas stations are the most common type that might occur in the future; and 3) data on concentrations of gasoline released and measured in the environment were available.

Health risks were evaluated by applying standard EPA risk assessment methods to the actual levels of gasoline detected at the site, and to levels that could exist under worst case assumptions.

o Information on Human Exposure

The exposures to gasoline used in the analysis were a combination of actual conditions and hypothetical worst case conditions. For releases to groundwater and to the air, individual

worst case exposures were calculated assuming pollutant concentrations that the least sensitive person in the population would be expected to smell or taste. Exposures were also calculated for actual levels of gasoline detected after the Northglenn leak.

Estimates of the total number of adverse health effects were based on the expected number of leaking USTs in Denver, national estimates of the number of persons exposed per leaking tank, and the individual risk levels calculated for the worst case and for the Northglenn scenarios.

o Impact on Human Health

The analysis of human health risks considered the effects of the primary toxic constituents of gasoline (benzene, toluene and xylene). The health information on the chemicals is based on Agency approved studies. Under worst case scenarios at the Northglenn release, the risks to an individual breathing gasoline vapors are higher than those to an individual drinking contaminated groundwater.

In the worst case, inhalation risks could be as high as 2 in 1,000 of developing cancer from a lifetime of exposure to concentrations just below the level at which a person would detect their presence.

Under more likely exposure scenarios, the risks could be between 10 and 100 times lower using national data on average failure, release and exposure rates. Given the assumptions of the study, the risks across the population under worst case conditions would result in less than one additional cancer case annually. Non-cancer effects from toluene and xylene would not be expected to occur at the levels detected at Northglenn. Health effects data were not available to estimate non-cancer health effects from benzene.

2. Other Health Issues/Limitations of the ESP Analysis

The analysis of human health risks posed by USTs in metro-Denver focused primarily on the chronic risks attributable to leaking petroleum tanks. Uncertainties about the actual number of leaking tanks in Denver, the number of persons potentially exposed to contaminants and the levels of these exposures are reflected in the range of individual and population risks.

Risks from underground storage tanks are unlikely to exceed the upper-bound estimates given the conservative assumptions underlying these scenarios. While the risks could be less than the lower bound estimates (in the event of very small release events or in situations where no one is actually exposed), risks are more likely to fall within the predicted range.

In evaluating the risks posed by USTs, it is important to recognize the possibility of other types of risks not analyzed for the Environmental Strategies Project. These include acute risks from short-term exposures or from events such as explosions. Data were not available to analyze the magnitude of acute risks.

The ESP analysis examined only health effects from exposure to the primary constituents of gasoline. Risk levels might be higher for chemical tanks leaking substances that are more toxic than common petroleum products, although there are only a relatively small number of such tanks in metro-Denver. Risks from leaking chemical tanks could be as high as those estimated in the analysis of hazardous waste treatment facilities.

B. Economic/Welfare Effects

A city with environmental contamination from widespread leaks and spills could suffer some loss of economic activity. Fires and explosions from UST leaks and spills may damage commercial and residential property. In the event that a responsible party is not identified, clean-up costs will be incurred by some level of government.

C. Ecological Effects

Leakage of petroleum products and hazardous chemicals into groundwater or surface water supplies can potentially inhibit its quality for years.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Awareness of the environmental problems posed by underground storage tanks and pressure for action exists primarily in areas which have experienced groundwater contamination, spills, or fires. The extent to which such events have been publicized by the media also influences public perception.

B. Regulatory Status

1. Legal Requirements

An interim prohibition established in the Resource Conservation and Recovery Act (RCRA) includes requirements that new USTs be protected against corrosion or structural failure and be made of material compatible with tank contents.

EPA has proposed regulations for the UST program that will replace the interim prohibition. These regulations will become effective on October 1, 1988. The new regulations include the requirements that:

- Leak detection standards be met within 3-5 years,
- Corrosion and spill prevention measures be in place within ten years,
- UST owners maintain the capacity to pay for cleanup, usually through liability insurance, at a minimum coverage of \$1 million per occurrence.

In October 1986 Congress established the Leaking Underground Storage Tank (LUST) trust fund for program development, conducting investigations, enforcement, and cleanup activities. This fund is to operate as a revolving account, beginning with \$500 million in revenues to be raised through taxes on fuel and other commodities.

The Colorado Department of Health uses LUST fund dollars for program development and leak investigations, but does not have the legislative authority to use the funds for enforcement, cleanup, or cost recovery.

2. Current Activities

Colorado has not adopted legislation authorizing state implementation of EPA's proposed UST regulations. If the State Legislature does not approve such legislation, EPA could administer portions of the program when the regulations are final through a memorandum of understanding with the State. However, this would not be a comprehensive or effective response to the problem as EPA is very limited in what it would be able to do.

A steering committee consisting of public and private sector officials prepared and proposed legislation which would have allowed adoption of the proposed federal UST program. This legislation was defeated in the 1988 Colorado State Legislative session. It is anticipated that new legislation will be introduced in the 1989 session.

3. Public Expenditures

The State of Colorado received \$200,000 in LUST trust fund moneys in FY 1987 to be used in FY 1988 and beyond. Additional allocations may be made in FY 1988 and FY 1989.

After the proposed Federal UST regulations become effective, allocations of LUST Trust Fund money to the State will require the State to provide a 10% match.

In FY87 and FY88, EPA provided a grant to Colorado for the development and implementation of the UST program. In FY 88 the state UST program budget was approximately \$200,000, of which 75% came from an EPA grant and the remainder from the state.

C. Possibilities for Further Control

As of April 1988, CDH has a well-developed UST database capable of cataloging the location of all known USTs. CDH intends to update this database regularly as new information becomes available. However, it must be noted that it is particularly difficult, and in some cases impossible, to locate USTs which are no longer in use. Control options for these abandoned USTs are basically limited to leak detection and/or research and removal of old tanks.

However, there are a range of technical options available to reduce the likelihood of a release of toxic material from USTs brought into use in the future. EPA, for example, is currently exploring five regulatory options designed to reduce the likelihood of tank failure. The baseline option requires corrosion protection for all new tanks and quarterly leak detection within 3 years of the adoption of new regulations for all existing and new tanks.

Under more extensive options, periodic tightness tests for existing tanks and secondary containment with interstitial monitoring for new tanks are required in addition to the baseline level controls.

The costs associated within these options vary between \$3,000-\$4,000 per tank. It is anticipated that these incremental costs should result in long-term savings to tank operators by reducing the opportunity for groundwater contamination and thus lowering future liability and cleanup costs.

IV. Work Group Findings

The work group was interested in this issue and endorsed further data collection on leaking USTs. In both 1987 and 1988, state legislation pertaining to USTs has been introduced but not passed. If the State is to have authority to deal with leaks, it needs legislative authority to do so.

ACTIVE MUNICIPAL LANDFILLS

I. ISSUE DESCRIPTION

There are seven active municipal landfills receiving solid wastes from homes and businesses located in the Denver metropolitan area. Small quantities of hazardous household chemicals are being disposed of in active municipal landfills. Of these landfills, two are located in Weld County (which is outside the six county metropolitan study area). If toxic materials stored in these landfills penetrate landfill barriers, wells and other water supplies may be contaminated.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

The potential risks associated with the Jefferson County landfill were characterized and then used to estimate the potential risks associated with the other active landfills in metro-Denver. Inactive landfills were not considered due to the limited data on these facilities. However, some officials believe inactive landfills may pose an even greater risk than active landfills.

The Jefferson County Landfill was selected for the analysis because: 1) Aside from Lowry Landfill, Jeffco is the largest municipal landfill in the study area, 2) Jeffco Landfill had experienced a seepage incident in the past, and 3) People are drinking ground water from private wells nearby. Due to the potential for ground water contamination, the study determined that Jeffco Landfill might pose risks greater than those at the other facilities in the study area. Please note that Lowry Landfill was not included in the active municipal landfill analysis. Instead, it was included as part of the Superfund analysis.

Health risks were assessed by applying standard EPA methods to contaminant levels that could exist if the leachate entered nearby drinking water supplies. A variety of exposure scenarios were evaluated to generate a likely range of risk.

o Information on Human Exposure

Exposures to contaminants at landfills were developed by modeling potential concentrations at drinking water wells and surface water supplies under a range of site conditions, e.g. ground water flow, number of people drinking from potentially contaminated wells and various leachate constituents which could potentially exist at the Jefferson County Landfill.

By varying the exposure scenarios, a range of potential risks was calculated. To estimate the number of people affected throughout metro-Denver, ESP applied estimates of the range of individual risks at the Jefferson County facility to the number of potentially exposed individuals at the other facilities.

o Impact on Human Health

The toxicity information used in the analysis was based on EPA approved laboratory experiments with animals. Under worst case conditions at the Jefferson County site, the risks to individuals drinking contaminated ground water are estimated to be 9 in 10,000 of developing cancer from a lifetime of exposure to maximum concentration of representative landfill contaminants. The risks are roughly 100 to 10,000 times lower under more likely exposure scenarios.

For the total population of metro Denver, even under worst case conditions, less than one additional cancer case is expected per year as a result of toxic contamination of drinking water by active municipal landfills. This result is attributable to the limited number of people drinking from wells near active municipal landfills. However, under worst case conditions small numbers of people could drink water with levels of toxics high enough to cause non-cancer health effects. Under more likely conditions, these levels are not expected to pose a threat to human health.

In the Jefferson County Landfill study, risks from ingestion of surface water were found to be substantially lower primarily because of the dilution of the contaminant in the surface water) than those associated with drinking contaminated groundwater from private wells.

2. Other Health Issues/Limitations of the ESP Analysis

The wide range of predicted individual and population risks is a reflection of the uncertainty inherent in the health risk estimates for municipal landfills. Significant uncertainties are introduced as a result of (1) our less-than-complete knowledge of release rates and hydrogeologic conditions at the Jeffco Landfill and (2) the process of extrapolating from one representative landfill to the other area sites.

Despite these uncertainties, we are relatively confident that the actual risks from active municipal landfills will not exceed the upper bound estimates identified in this study. These upper bounds are based on worst case assumptions about contaminant release rates, groundwater flows, and the location and number of persons exposed.

A more significant uncertainty arises from the limited scope

of the analysis. As mentioned above, only active municipal landfills were analyzed.

Regarding other health hazards associated with active landfills, CDH reports that landfills in the Denver metro area are generally in much better shape than active municipal landfills in much of the rest of the State. CDH attributes this to the fact that Denver's landfills have a predictable stream of revenue based on volume and dependability of clients and consequently they have a level of management not possible elsewhere.

B. Economic/Welfare Effects

Off-site contamination may limit opportunities for land use near landfills. Increased traffic caused by the passage of garbage trucks also has a potential impact.

C. Ecological Effects

Improperly managed landfills may well have detrimental impacts on floodplains, endangered species, groundwater, soil, air, and surface water.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Public concern is frequently voiced over the environmental effects of Denver-area landfills. It is also known that people fear the effect a landfill or a transfer station may have on their property values. Lowry Landfill is often referred to as an example of the detrimental effect having a landfill next door can have on property values. It must be remembered, (and often people forget or do not know) that Lowry is a product of both solid landfilling and industrial waste dumping. Clearly, Lowry is not a classic municipal landfill.

B. Regulatory Status

1. Legal

- a. Regulation of solid waste disposal is covered by Subtitle D of the Resource Conservation and Recovery Act (RCRA). Subtitle D uses the following mechanisms to address active municipal landfills:
 - o Minimal technical standards for all solid waste disposal facilities,
 - o A provision under which any person may begin a civil action on his own behalf against any person or governmental agency allegedly in violation of RCRA

Subtitle D.

- b. States are the implementing authority for Subtitle D.
- c. New federal regulations are pending which place more specific requirements on the operation and closure of municipal landfills. EPA is expected to issue a draft of these regulations in 1988.

2. Current Activities

The Denver Regional Council of Governments (DRCOG) has performed an issues analysis for solid waste management in the Denver region and is attempting to raise funds to develop a Regional Solid Waste Management Plan during 1988-89. The plan would assess the region's solid waste management problems, evaluate options for dealing with solid waste in the region, develop a set of regional goals and policies regarding solid waste management and implement these goals and policies. In order for this effort to succeed, DRCOG will need metro-wide encouragement.

3. Public Expenditures

RCRA subtitle D was designed to be a state effort and is not funded by the federal government. However, the Colorado Department of Health has not been able to get an appropriation to fully perform this function. Hazardous waste programs are an exception and receive federal funds.

C. Possibilities for Further Control

There are several strategies for approaching the management of solid wastes in landfills. One certainly is to build better disposal sites. Another involves using alternative disposal practices such as incineration, waste-to-energy, recycling, separation, etc.. And yet another considers ways to reduce the bulk of solid wastes before they become a problem, e.g. waste minimization. State officials have indicated the need to consider all three approaches.

IV. WORK GROUP FINDINGS

The work group acknowledged the difficulty the metro area has had in implementing a regional solid waste plan and in developing better metro-wide cooperation for waste disposal. They agreed that the problem can no longer be defined as a lack of data or insufficient technological options or information. Consequently, the work group recommended strategies for promoting a workable and lasting institutional solution to the problem.

INACTIVE MUNICIPAL LANDFILLS

I. ISSUE DESCRIPTION

Inactive municipal landfills can cause environmental problems when precautions to inhibit contamination of groundwater, surface water, and air have not adequately been incorporated into the initial landfill design or retrofitted before the landfill was closed.

The extent of this problem is not known. Many questions exist regarding off-site contamination from inactive landfills: some data are available but many sites have not been tested or documented. Furthermore, the rate at which problems develop is also not well understood.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

Due to time and budget constraints the potential health effects of inactive landfills were not assessed by the Environmental Strategies Project.

2. Other Health Issues

Potential health effects include injuries or deaths from methane gas explosions, collapse of poorly stabilized soils, erosion and leachate seepage.

B. Economic/Welfare Effects

Development opportunities for land on and around inactive landfills may be limited by contamination. In the event of a fire or explosion caused by leaking gases, nearby homes and businesses may be damaged. Future settling of the soil in a landfill may make it impractical to build structures above the old landfill.

C. Ecological Effects

Leakage and off-site migration of toxic and hazardous wastes can cause contamination of air, groundwater, and surface water.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Public awareness of potential hazards posed by inactive municipal landfills is generally limited to the area surrounding a particular problem site. Public concern has been voiced in Jefferson County, where there is potential groundwater contamination from two inactive landfills--the Leyden and Rooney Landfills. Methane explosions that killed several people in Adams County several years ago caused a great deal of local concern.

B. Regulatory Status

1. Legal Requirements

- a. Management of inactive landfills is not directly addressed by the Resource Conservation and Recovery Act (RCRA). However, if an inactive landfill meets certain stringent criteria, it can potentially fall under the Superfund program.
- b. Active landfills which become inactive must comply with post-closure requirements stated in county permits. The Colorado Department of Health requires landfill owners receiving a certificate of designation (CD) from a county agency to monitor off-site contamination for ten years following closure of the facility. Because this requirement has been in place less than 5 years, those facilities which closed prior to the new requirement are not necessarily being monitored.

2. Current Activities

CDH is in the process of developing a Waste Site Inventory system which would identify inactive landfills. The development of this system is dependent both on funding and on the availability of location information. The data system is a long-term project and may require several years to bring on as an active database.

3. Public Expenditures

No State or EPA Region VIII dollars were allocated to any aspect of inactive landfills (other than Superfund dollars) in FY 1988. To date, the Legislature has chosen not to fund a comprehensive solid waste program in Colorado. As a result, the conditions of the inactive landfills are not under any review except whatever limited effort is conducted at the local level.

C. Possibilities for Further Control

Known problems are being addressed to the extent possible by Superfund. For other possible problems there is a lack of funding.

The attitude of some local governments is that they will address a problem caused by an inactive landfill if and when it becomes obvious or pressing. The attention and efforts to mitigate potential harm from methane explosions in the late 70s is a relevant example.

IV. WORK GROUP FINDINGS

The work group was divided in its opinion as to whether or not inactive sites pose significant long-term hazards to the Denver metro area. As a result, it concentrated its efforts on problems for which more extensive data were available.

HAZARDOUS WASTE GENERATORS

I. ISSUE DESCRIPTION

There are approximately 815 generators of hazardous waste in the metro Denver area. Most of these generators (90%) produce less than 2,200 lbs/month and are considered small quantity generators (SQGs). The remainder (10%) produce more than 2,200 lbs/month and are considered large quantity generators (LQGs). The LQGs produce more than twice the total amount of hazardous waste than the SQGs, 7,857 metric tons for LQGs compared with 3,255 metric tons for SQGs.

Mishandling of hazardous waste either by small or large quantity generators can result in contamination of groundwater, surface water, soil, or air--posing health risks to nearby populations.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

The lack of data on the types and frequency of LQG and SQG waste management practices make it extremely difficult to quantify potential risks associated with hazardous waste generators. A analysis produced the following conclusions:

- o For generators in compliance with regulations, the only significant risks are those posed by short-term storage of wastes. The likelihood of releases from such storage is low.
- o Facilities not complying with regulations may well pose significant risks. Releases to air, groundwater or surface water may be caused as a result of poor storage practices, discharge to publicly operated treatment works or illegal disposal. Due to the larger number of facilities, non-complying SQGs probably pose a greater hazard than the LQGs.

2. Other Health Issues

Health risks from hazardous waste generators may result from improper disposal of wastes, for example into the sewers and other forms of "midnight dumping". Also of concern are accidental releases of waste materials. In order to reduce the incidence of improper disposal, practical alternatives need to be available, affordable and convenient.

In reference to accidental releases, if generators follow emergency response procedures, exposure from such releases is likely to be short-term and the health risk will be relatively low. Generators not complying with such procedures can cause health risks that equal or exceed risks associated with other waste management facilities.

B. Economic/Welfare Effects

Most impacts from the migration of hazardous waste constituents from generation sites are localized in nature. However, in cases where migration causes widespread contamination of a city's drinking water supply or other resources, such damage can dissuade people and business from locating in the area and/or encourage existing residents and businesses to move elsewhere.

Mismanagement of hazardous waste can lead to fires or explosions, as well as to health and environmental effects. Damages can include destruction of buildings, damage to crops and fisheries, and loss of work hours.

C. Ecological Effects

Improper management or accidental releases of such substances can create long-term damage to water resources, vegetation, wildlife and wetlands.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Public concern about hazardous waste generators is generally limited to companies which are obvious waste producers, e.g., chemical companies. Service businesses, high technology companies, and small businesses are often overlooked as waste generators.

B. Regulatory Status

1. Legal

- a. The Resource Conservation and Recovery Act (RCRA) initially required generators of more than 2,200 lbs/month of hazardous waste to: notify EPA of their activities; to ship wastes only to certified treatment, storage, or disposal facilities; and to comply with EPA regulations regarding the handling and storage of these wastes.
- b. As set out in the Hazardous and Solid Waste Amendments (HSWA) of 1984, the federal regulations for hazardous waste management were modified to bring businesses that generate more than 220 lbs per month of hazardous waste

into the regulatory system. Previously, small quantity generators that generated less than 2,200 pounds of hazardous waste in a calendar month had been exempt from most hazardous waste regulations.

2. Current Activities

- a. The Colorado Department of Health (CDH) is responsible for implementing RCRA regulations with regard only to large generators. Regulatory activities for small quantity generators is handled by EPA pending delegation of HSWA authority to the State.
- b. CDH issues permits to businesses generating hazardous waste according to the amount generated per month and enforces these requirements. CDH also issues guidelines and public information for use by individuals and companies producing quantities of hazardous waste less than 220 pounds.
- c. During 1987 the Colorado Association of Commerce and Industry (CACI) conducted educational seminars for small generators on RCRA requirements.

3. Public Expenditures

Small and large quantity waste generators fall under the purview of RCRA. The RCRA budget is organized along functional lines which do not exactly correspond to the specific environmental problems analyzed by the ESP.

As stated in the FY 1988 STATE EPA AGREEMENT (SEA), the FY 1988 budget for RCRA programs, including those related to generators and TSDFs (treatment, storage and disposal facilities), included an allocation of \$680,000 to the State of Colorado to be used for RCRA contract expenditures. This number does not include the amount EPA Region VIII, itself, spends in Colorado on RCRA personnel and contracts spent on RCRA programs which are not passed through the State. In FY88 the State of Colorado allocated \$246,500 (includes cash plus general fund) to RCRA activities.

C. Possibilities for Further Control

The regulatory mechanism is in place but in order to insure full compliance by all generators, more funding is necessary.

IV. WORK GROUP FINDINGS

The work group was interested in the lack of available data in regard to the waste management practices of small quantity generators. The suggestion was made to work with small business trade associations in an effort to improve both business' and

policy-makers' understanding of such practices. Once the magnitude of the problem is more clearly understood, remedial efforts may need to be increased.

TRANSPORTATION OF HAZARDOUS MATERIALS

I. ISSUE DESCRIPTION

Proper shipping and tracking of hazardous materials is critical to protect the public from potentially harmful health risks. An accidental release of such materials during transportation can affect a large segment of the population, as well as harm the natural environment.

Hazardous materials include petroleum, chemicals, explosives, hazardous waste, and other substances. While hazardous waste is the only type of hazardous material regulated under RCRA, other hazardous materials make up a larger volume of total hazardous materials being shipped.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

The initial Environmental Strategies Project analysis only looked at the risks associated with the transportation of hazardous wastes. The results of this analysis have not been included in this report but are available upon request. In order to grasp the actual risks associated with the transportation of hazardous materials, the work group strongly recommended that the ESP expand its analysis to encompass hazardous materials.

2. Other Health Issues

The primary concern associated with hazardous materials transportation is the potential acute health effect from an accidental release. An acute effect is one which occurs immediately after an exposure to a harmful substance. Such effects may be reversible as in the case of a headache, or irreversible as in permanent lung damage.

B. Economic/Welfare Effects

Accidental releases of hazardous materials during transportation may cause fires and long term damage to property. Economic loss and disruption may also occur from road closure for emergency response activities. In cases where cities heavily regulate transportation of materials on local roads, some loss of business activity may occur.

C. Ecological Effects

Contamination from transportation spills can cause damage to nearby vegetation, surface water, groundwater, and air quality.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

A few accidents have heightened the awareness of potential dangers from hazardous materials transportation. A toxic substance spill from a train and a freeway incident where a truck carrying torpedoes overturned, both of which occurred in north Denver, have increased public concern about hazardous materials being shipped through the metropolitan area.

Several cities in metro Denver have adopted ordinances restricting the use of certain urban roadways for the transportation of hazardous wastes. Public involvement in helping to determine these routes has been moderate.

B. Regulatory Status

1. Legal Requirements

- a. In 1974, Congress adopted the Hazardous Materials Transportation Act (HMTA). The HMTA authorized the U.S. Department of Transportation (DOT) to adopt rules regulating the transportation of hazardous materials.
- b. The Department of Transportation (DOT) has issued rules governing the packaging, marking, and placarding of all hazardous materials. DOT works with EPA and the Colorado Department of Health (CDH) in regulating the transportation of hazardous waste under RCRA.
- c. The Resource Conservation and Recovery Act (RCRA), Subtitle C, requires transporters of hazardous waste to register with the EPA, deliver waste only to permitted treatment, storage, or disposal facilities (TSDFs) using the manifest provided by the waste generator, and deal with any waste spills in accordance with EPA regulations.
- d. Recently enacted legislation in Colorado SB 156 (1987) established statewide regulations for the transportation of hazardous materials. The law establishes a permit system and a fee schedule for hazardous material carriers. It requires the Colorado State Patrol to designate routes and establishes penalties for deviation from routes or violation of permit and fee provisions. It also establishes the Colorado Safety Institute to train personnel involved in transportation and cleanup of hazardous materials.
- e. The Colorado Public Utilities Commission administers regulations regarding permitting of hazardous and radioactive waste carriers, enforces permit compliance

and obtains records of insurance compliance.

- f. The Colorado Department of Public Safety (DPS) currently promulgates routes for hazardous materials carriers. It provides enforcement and emergency response in conjunction with local police and fire departments, initiates emergency response planning activities in counties and municipalities and inspects nuclear waste shipments that originate in Colorado. The Colorado State Patrol, the newly established (1987 S.B. 156) Colorado Safety Institute and the Division of Disaster and Emergency Services (DODES) all fall under DPS. Each of these divisions has a role in reference to this topic.
- g. The Colorado Department of Revenue, Ports of Entry, is responsible for enforcement of vehicle safety standards for cargo carrying vehicles. Hazardous material vehicles are inspected for proper placarding and safety features. Ports of entry issues trip permits for carriers entering the State.
- h. The Colorado Department of Highways is responsible for designating routes for radioactive waste shipments. Safety and policy analysis is conducted to determine the best routes.
- i. EPA Region VIII's Hazardous Materials Response Team responds to spills incurred by hazardous waste transporters in accordance with responsibilities under the Superfund Amendments and Reauthorization Act, SARA Title III.

2. Current Activities

The Interagency Task Force on Hazardous Materials Transportation is an effort which is intended to provide coordination and planning among state and local governmental agencies. This task force has been run out of the Governor's office since the mid-1970s.

3. Public Expenditures

This "line item" is particularly complex due to the fact that so many different budgets are tapped to handle transportation incidents. All of the agencies and divisions mentioned above, including local fire departments, and in some areas, emergency response teams are involved. Therefore, it was not possible to obtain a relevant public expenditures figure for this issue.

C. Possibilities for Further Control

Once decision-makers have a better understanding of the basics: what is being transported, where, how often, etc.,

additional control options should become more obvious.

IV. WORK GROUP FINDINGS

After an overview of this topic, the work group decided to recommend a well coordinated metro-wide data analysis effort which would, at a minimum, take the following factors into consideration: current and anticipated hazardous materials transportation routes; adequacy of emergency response coverage and areas of high and low population. If integrated and updated, this information could enhance decision-makers' ability to manage this area of public policy.

HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES--TSDFS

I. ISSUE DESCRIPTION

There are 13 active and 16 inactive hazardous waste treatment, storage, and disposal facilities (TSDFS) in the metro-Denver area. The 13 active facilities manage an estimated 75% of the hazardous waste generated in the Denver metropolitan area, much of which is eventually shipped offsite. Nine of the 13 active facilities manage wastes generated solely by their own operations. The remaining four active facilities handle wastes from other generators.

If improperly stored or treated waste migrates off the site, contamination of drinking water, air or soil may occur.

II. IMPACT ASSESSMENT FACTORS

A. Public Health Issues

1. Environmental Strategies Project Analysis

o Analytical Approach

The risks associated with hazardous waste releases at TSDFS were analyzed by modeling the releases under a range of conditions at a hypothetical facility, and then extrapolating the results to Denver's existing facilities.

The hypothetical facility was developed because site-specific data for metro Denver TSDFS were not adequate to assess risks. The hypothetical facility is a composite of waste, hydrogeologic conditions, and exposure pathways that could, in theory, exist at the 29 active and inactive TSDFS in metro Denver.

Standard EPA risk assessment methods and health information were used in combination with exposure information from the hypothetical facility to estimate the range of potential risks.

o Information on Human Exposure

A range of exposure conditions possible at metro Denver TSDFS was considered. The primary pathway evaluated was a release of organic solvents to a drinking water aquifer.

Risks from contaminated surface water were judged to be less than the risks associated with contaminated ground water because most surface water is treated prior to consumption while ground water often is not.

Exposures to air releases were not considered because of inadequate data. An estimate of the number of potentially exposed

people across the study area was developed using local data on the number of people living around TSDFs in the study area and the percentage of these people likely to be served by drinking water from untreated wells.

o Impact on Human Health

The primary objective of the TSDF analysis is to provide information on the range of chronic human health risks which might be caused by releases of hazardous substances from metro-Denver waste management facilities. The upper-ends of the individual and population risk ranges identify maximum levels that are unlikely to be exceeded even under worst-case assumptions about waste release, groundwater transport and human exposure conditions in metro-Denver.

The range of potential risks from TSDFs could be wide. Applying worst case conditions, individuals drinking contaminated ground water over a lifetime could experience a 1 in 100 chance of developing cancer.

Under more likely TSDF conditions, the risks could be 100 to 10,000 times lower. Because only a small percentage of the population is likely to drink from affected wells, less than one additional case of cancer per year would be expected even under worst case conditions.

Lower bounds represent risks under relatively optimistic assumptions (e.g., those resulting in low risk) about the quantity and toxicity of pollutants released and the location and number of people exposed. In the event that no one is actually exposed, these lower bounds would overestimate risks. However, we believe overall that risks are more likely to occur within the predicted range than at either the upper or lower bounds.

The basis for these risk estimates is exposure to benzene, a known carcinogen that can also cause non-cancer health effects. It is important to note that one would not expect to find benzene at every TSDF.

2. Other Health Issues/Limitations of the ESP Analysis

In reviewing the risk ranges for TSDFs, the reader should recognize that data and/or resources were not available to analyze all possible exposure pathways. Our assessment considers only chronic risks from off-site ingestion of contaminated groundwater. Chronic exposures to pollutants released to air and surface water and acute exposures due to accidental releases were not be considered in this analysis. In general, the risks due to air and surface water releases are expected to be lower than those posed by contaminated groundwater.

B. Economic/Welfare Effects

Widespread contamination of air or water resources by hazardous wastes not properly treated, stored, or disposed of can discourage people and business from locating in the area, and reduce revenues from tourism and recreation.

Releases of hazardous waste constituents into groundwater or surface water used for human or livestock consumption can have negative impacts on personal and business income. Airborne hazardous substances can damage crops, livestock, fisheries, and other sources of income.

C. Ecological Effects

Improper treatment, storage, or disposal techniques can result in releases of chemicals into soil, groundwater, surface water, or air. Such releases can cause long term damage to water resources, vegetation, wildlife, and wetlands.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

Local residents are often concerned about potential migration of pollutants from TSDFs. TSDF releases can affect ground water, air and surface water. In some cases residents believe TSDF's have the potential to lower property values.

TSDFs causing public concern include Rocky Flats, Rocky Mountain Arsenal, Martin Marietta and the Denver-Arapahoe Chemical Waste Processing Facility. The permit issued to Browning-Ferris Industries to operate a major commercial disposal facility in Adams County generated a great deal of attention and concern.

B. Regulatory Status

1. Legal

- a. The Resource Conservation and Recovery Act (RCRA) requires treatment, storage and disposal facilities (TSDFs) to obtain a permit from EPA to ensure their safe operation. Most TSDFs are operating under interim status pending review and approval of permits by the State and EPA.
- b. The Hazardous and Solid Waste Amendments (HSWA) of 1984 provided additional authority for corrective action at TSDFs to remedy past problems. The Land Ban provision phases in restrictions on land disposal of untreated wastes.

2. Current Activities

- a. The Colorado Department of Health (CDH) is responsible for implementation of RCRA responsibilities for TSDFs, with EPA's oversight and assistance. Responsibilities under HSWA have not yet been delegated to the State. The State has submitted its HSWA application which is currently under review by EPA. Colorado is expected to receive authorization in Summer 1988.
- b. CDH issues site-specific permits for TSDFs specifying the type of treatment, storage, or disposal activities which may take place. These permits may be effective for up to 10 years.
- c. CDH is also responsible for reviewing and approving closure plans of TSDFs, which are required when a facility ends its operations. In this process, as well as the permitting process, CDH involves local agencies and the general public through public review and comment.
- d. As noted in the Superfund issue paper, the Governor has formed a special citizens task force to monitor Rocky Flats activities and recommend further cleanup activities.

3. Public Expenditures

TSDFs fall under the purview of RCRA. As is described in several other issue papers, the RCRA budget is organized along functional lines which do not exactly correspond to the specific environmental problems analyzed by the ESP.

Budget figures for RCRA programs including those related to generators and TSDFs were quoted in the FY 1988 STATE EPA AGREEMENT (SEA) as follows. For FY 1988, EPA Region VIII indicated plans to allocate \$680,000 to the State of Colorado to be used for RCRA contract expenditures. This number does not include the amount EPA Region VIII, itself, spends in Colorado on RCRA personnel and contracts spent on RCRA programs which are not passed through the State.

FY 88 the State of Colorado to allocated \$246,500 to RCRA activities. In addition to some State General Fund money, the Colorado TSDF permitting program is cash funded by permit fees and annual operating fees collected by the State.

C. Possibilities for Further Control

The regulatory mechanism for TSDF control exists, however, full implementation of this program will require increased funding.

IV. WORK GROUP FINDINGS

The Land Ban provisions and RD&D (Research, Development and Demonstration) program created under the 1984 RCRA amendments (and the Superfund program) have given considerable national impetus to the development of more economic and effective means of treating wastes. In light of an interest in promoting local innovation, the work group discussed the desirability of exploring ways to streamline the new technology permitting process so that an entrepreneur who engages in such innovation has a measure of assurance that a newly developed technology will be permitted under EPA standards.

E. ENVIRONMENTAL LEAD EXPOSURE

STAFF CONTACT:

Patrick Cummins 293-1621

ENVIRONMENTAL LEAD EXPOSURE

I. ISSUE DESCRIPTION

Lead toxicity is a prevalent and persistent environmental health problem. Lead poisoning is known to cause anemia, neurological disorders, reproductive problems, and other effects.

Recent studies have shown adverse effects at lower blood lead levels than were previously recognized as harmful. These effects include decreased mental development in children, hypertension in adults, and lower birth weights in infants.

Lead in the environment to which humans can be exposed originates from numerous sources including leaded solder on water pipes, lead-based paint in older homes, and lead in gasoline.

II. IMPACT ASSESSMENT FACTORS

A. PUBLIC HEALTH ISSUES

1. Environmental Strategies Project Analysis

o Analytical Approach

Several EPA studies have calculated the relationship between environmental lead concentrations and blood lead levels. The results of these studies were used in conjunction with data on lead in drinking water from four Colorado communities, and data on lead in Denver's air, to estimate 1986 blood lead levels in metro Denver.

These blood lead levels were then used to predict the incidence of lead-related health problems.

o Information on Human Exposure

Nationwide information on the relationship between blood lead levels and lead concentrations in air and drinking water was used with estimates of Colorado environmental lead concentrations to predict 1986 blood lead levels in metro Denver.

Information on the age of Denver's housing was combined with local demographic information to estimate the number of children that might be expected to experience elevated levels of lead in their blood as a result of exposure to lead in paint or dust.

o Impact on Human Health

Researchers have documented a variety of adverse health effects caused by exposure to lead. These include kidney,

neurobehavioral, and reproductive effects. Of particular concern are neurological effects in children. Childhood exposures to levels of lead previously believed safe are now thought to affect certain cognitive functions as measured by reduced IQ.

The ESP analysis estimated the number of adverse health effects attributable to exposures to lead in the air, in drinking water, and in paint. The results indicate that as many as 1,150 children in metro Denver may be at risk from exposure to lead paint.

The number of effects attributable to lead in air and drinking water are substantially lower than those attributable to lead in paint. Furthermore, air and drinking water exposures are expected to diminish over time as leaded gasoline is taken off the market and as Colorado's ban on leaded solder used in the plumbing industry takes effect.

2. Other Health Issues/Limitations of the ESP Analysis

While the ESP analysis of exposure to environmental lead in metro Denver examined all of the major health issues, there is a great deal of uncertainty in the results of this analysis.

The uncertainty in the analysis stems from the fact that very little is known about blood lead levels in the metro Denver population. Because of this lack of data, blood lead levels had to be estimated using limited Denver specific information along with the results of nationwide studies.

B. Economic/Welfare Effects

An EPA analysis of the benefits of reducing lead in drinking water (Dec. 1986) estimates the net annual monetized benefits to the nation from lowering the level of lead in drinking water from 50 micrograms per litre to 20 micrograms per litre at approximately \$800 million.

This estimate includes children's medical costs, costs of children's decreased mental development, savings from fewer heart attacks, strokes and deaths in adult males, and benefits of reduced corrosion damage to materials. Scaling this estimate to the metro Denver population correlates with net benefits of approximately \$6 million annually for a similar decrease in the level of lead in drinking water.

If, as the ESP analysis indicates, and as some area health professionals believe, the effects of lead-based paint are more severe than the effects of lead in drinking water, particularly for young children, the magnitude of these monetized economic and welfare effects could be significantly higher.

C. Ecological Effects

Lead in soils can be taken up by plants and enter the food chain through animals that feed on the plants.

III. ENVIRONMENTAL MANAGEMENT FACTORS

A. Public Perception/Political Pressure

There is little evidence to suggest that members of the community perceive exposure to environmental lead to be a serious problem.

B. Regulatory Status

1. Legal Requirements

EPA has an established Maximum Contaminant Level for lead in drinking water, and no systems in the Denver area are in violation of this standard. However, because most lead occurs in drinking water as a corrosion by-product of in-home plumbing, the sampling method used to determine compliance with the standard does not indicate actual levels at the tap.

The 1986 Amendments to the Safe Drinking Water Act require states to conduct a public notification that provides information on the sources of lead in drinking water, potential health effects, ways to reduce exposure, and information on public water supplies that are taking measures to address the issue.

Colorado recently instituted a ban on the use of leaded solder on water pipes, as required by the Safe Drinking Water Act.

Regulations under the Clean Air Act to phase down the amount of lead in gasoline have been in place since the early 1970's. At that time, lead levels in gasoline were as high as 5-6 grams per gallon. Today, leaded gasoline can contain no more than 0.1 g/gal.

2. Current Activities

EPA is in the process of reexamining the Maximum Contaminant Level (MCL) for lead in drinking water, and is expected to lower the standard by more than half, and to change sampling requirements significantly. Initial projections are that some area water supplies may be out of compliance with the newly proposed MCL.

Some public water supplies in the metro area have distributed informational pamphlets on lead in their monthly bills to customers.

3. Public Expenditures

Personnel in the public water supply sections at both EPA and CDH are spending substantial amounts of time on the issue of lead in drinking water. Much of this time is being spent on education. State employees have produced the public notification document which will be published in May of this year.

C. Possibilities for Further Control

The ban on lead solder should be effective in reducing lead in drinking water in the near future. Educating people about the potential problem and things they can do to reduce their risk of exposure to lead in drinking water can help minimize problems almost immediately.

IV. WORK GROUP FINDINGS

The ESP did not convene a work group to examine the environmental lead issue, however, the drinking water work group discussed the ESP lead analysis and recommended a comprehensive sampling effort to better understand human exposure to lead in drinking water.

In discussions with Advisory Committee members and their staff prior to the last meeting, several people suggested undertaking a blood lead sampling effort. This type of effort is needed due to the lack of data on blood lead levels in metro-Denver.