ENVIRONMENT 2010

THE STATE OF THE ENVIRONMENT REPORT

VOLUME I

Introduction and Overview

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ENVIRONMENT 2010

Washington Environment 2010

State of Washington
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State of the Environment Report

Volume I

Introduction and Overview

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Acknowledgements

The State of the Environment Report is an integral product of the Washington Environment 2010 Program. The following members of the Washington Environment 2010 Committees contributed to the production and review of this report.

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I. Introduction

As global society anticipates a new millienium and, more specifically, as the State of Washington celebrates its centennial, it seems an appropriate time to review the state of Washington's environment and to look forward to the next century. The State of the Environment Report is one of several products of an ambitious long-range planning program for environmental resources called Washington Environment 2010. Washington Environment 2010 is an effort to build a broad-based vision for the future of the state's resources and to formulate an action plan to build that future. The State of the Environment Report provides the foundation for such planning by presenting a picture of the current status of environmental resources, significant continuing or emerging threats or risks to continued enjoyment of those resources, and future projections given some of the current identifiable trends. Presentation of this picture is intended to inform the ensuing public discussions of the desired future for Washington's environment, the actions necessary to ensure the desired future is created, and the priority of those actions.

This report represents a first effort at a comprehensive look at the state of the environment. Although some aspects of environmental resources have been previously documented (e.g. air quality trend reports), comprehensive state of the environment reports have not been compiled. As a first effort, this report may be as significant for documenting what we don't know or are uncertain of as for what can be definitively said about the state of the environment. Updated state of the environment reports will be prepared on a periodic basis and will reflect improvements in our ability to characterize the status of environmental resources.

This State of the Environment Report has been organized into three separate but complimentary volumes. Volume I is the introduction and overview contained herein. Volume II is comprised of a series of reports that characterize the state's environmental and natural resources: air, water, land (forest, recreation, range, and agricultural lands), wetlands, fisheries and shellfish, and fish and wildlife. The resource characterizations in Volume II contain summaries of those risks that impact the specific resource. Volume III is comprised of a series of reports evaluating the human health and ecological risks posed by 23 threats to environmental resources (see Figure 1, page 5). Volume III is also supplemented by an appendix of information regarding the risks of economic damages associated with the same threats to resources. The information contained in all three volumes is also available in a condensed report for more extensive public distribution.

This overview volume includes five additional sections. Section II describes the background, structure and process for both Washington Environment 2010 and the State of the Environment Report. Section III discusses the context for the 2010 program and this report, both in terms of related global issues and statewide planning issues other than those addressing environmental resources. Section IV outlines the analytical approach and methods used to prepare this

report. Section V highlights some of the results from the resource characterization and risk evaluation reports contained in Volumes II and III. Finally, Section VI presents some of the key patterns and findings that are supported by the results. Section VI concludes by outlining the next steps of the Washington 2010 Program and how those steps build upon the foundation of information contained in this State of the Environment Report.

II. Background, Structure, and Process

Since the Alternatives for Washington Program in the 1970's, no formal, comprehensive long range planning has been undertaken for Washington's environmental resources. Recognizing the need to anticipate emerging issues, establish long term priorities, and emphasize prevention rather than reaction in addressing environmental resource issues, the Governor's natural resource management agency directors began discussing a major commitment to long range planning in the summer of 1988.

Coincidentally, the U.S. Environmental Protection Agency (EPA) expressed its interest in supporting a long range planning program which would incorporate comparative risk analysis. EPA has supported several local, state and regional projects across the country which used comparative risk analysis as a tool to assist in determining environmental management priorities. These projects, including a project for EPA's Region 10 office (covering Alaska, Idaho, Oregon, and Washington) are a followup to EPA's national report, Unfinished Business: A Comparative Assessment of Environmental Problems (February 1987). In October, 1988, the State of Washington, represented by the Department of Ecology (Ecology) and EPA executed a Memorandum of Understanding which provided substantial EPA support for a long range planning program utilizing comparative risk analysis as a basis for evaluating environmental management priorities and for developing an action plan in the context of a major effort for public outreach and dialogue. The concept and methodology of comparative risk analysis will be described in greater detail in Section IV.

On December 15, 1988, Washington Environment 2010 was formally established and publicly announced by the Governor (Executive Order 88-09). The Governor's Executive Order authorized a Steering Committee of state agency directors and established a Public Advisory Committee consisting of individuals representing diverse interest groups and governments. The Public Advisory Committee, in cooperation with the Steering Committee, was given a mandate to consider current and emerging issues in environmental resource management and to develop an action plan to aid both the public and private sector in setting priorities in pollution prevention, development, and natural resource management. Staff support for the program was authorized from Ecology, EPA, and through an interagency technical committee. Program staff and the technical committee, with review provided by the Public Advisory Committee, were assigned to prepare Washington's first "State of the Environment Report."

Pursuant to the Steering Committee's direction, the interagency Technical Advisory Committee was organized and convened in late November, 1988. The Technical Advisory Committee structure and membership was reviewed by the Steering Committee and included representatives from each of the environmental protection and natural resource management agencies on the Steering Committee. Technical specialists were chosen by the agencies and membership was broadened to include specialists from each of the major program or subject areas within the scope of the State of the Environment Report.

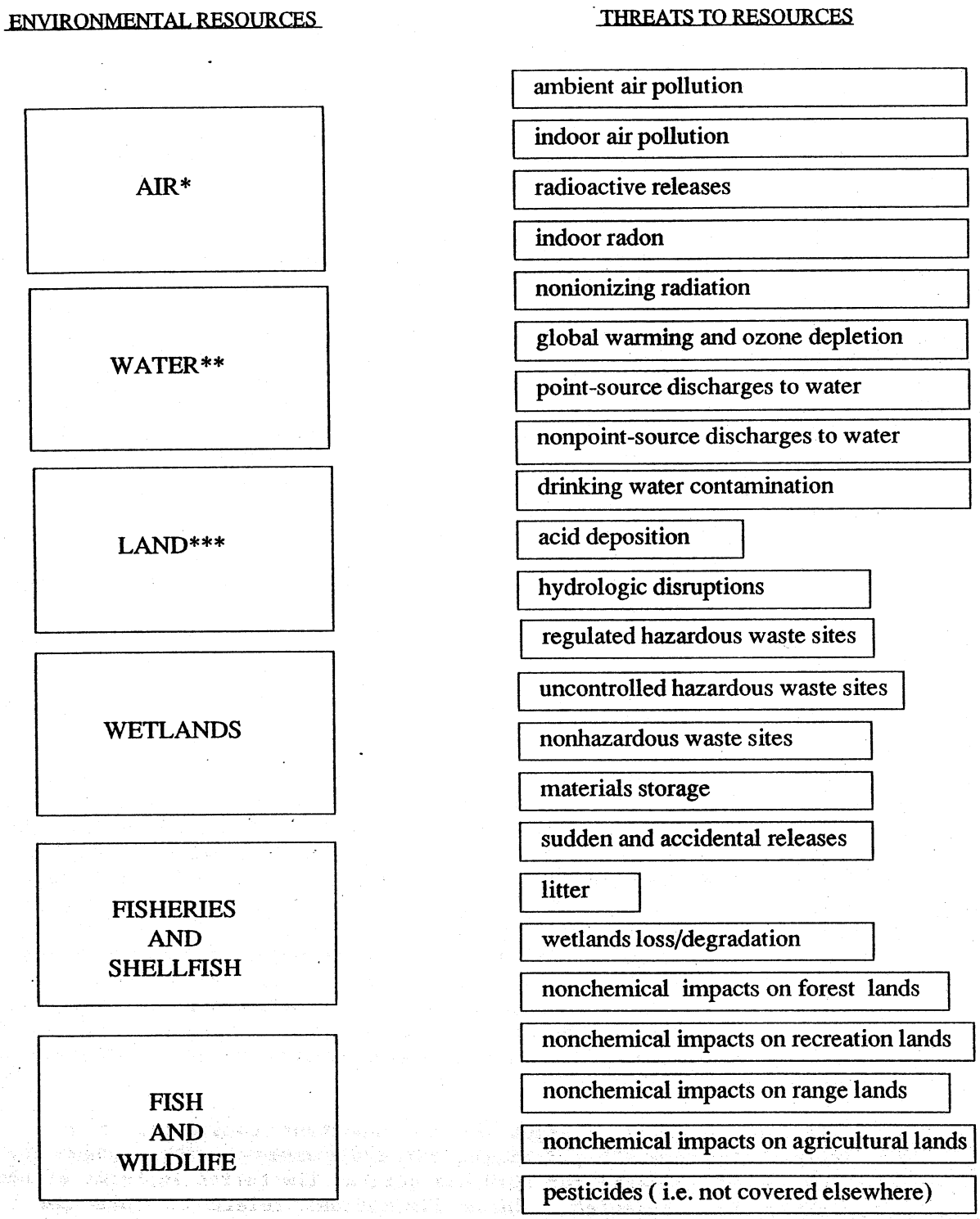
Initially, the Technical Advisory Committee focused upon identifying the subject areas to be addressed within the State of the Environment Report given the Steering Committees' commitment to characterize the state's environmental resources and to evaluate the comparative risks to those resources and to public health. After considerable discussion, the Technical Advisory Committee resolved to characterize six resources and evaluate risks associated with 23 threats to those resources (Figure 1). Risks evaluated were risks to human health, risks to ecological systems, and risks of incurring economic damages, although it was recognized that not all types of risk would be relevant to all 23 threats. For example, health risks are generally not a concern when considering nonchemical (i.e. physical) impacts upon land resources and ecological risks are generally not a factor in assessing indoor air pollution.

The final list of resources and threats contain significant overlaps and interrelationships which required clarification in the course of the analysis and report preparation. The boundaries around each subject area were discussed and established, and overlaps and omissions were acknowledged. For example, forest lands include land set aside for recreation, and agricultural and range lands overlap. Also, indoor radon is a specific subset of indoor air pollution, and drinking water contamination can result from several of the other threats as well as from contaminants within the drinking water system itself. Each of the listed resources and threats were viewed as distinct and involving different issues. Most of them are also the subject of specific program activities within state government. The intent of the Technical Advisory Committee was to characterize each resource and evaluate each threat as a distinct and definable subject while identifying and acknowledging the sometimes arbitrary nature of the boundaries.

As part of the process of defining subject areas, broad limits in scope were established. A fundamental limit on scope was to focus on threats and associated risks caused by human activities. Risks associated with "natural events," such as earthquakes, volcanic eruptions, drought, floods, etc., were not evaluated. However, with the emergence of such issues as global warming and the variety of human disruptions of the hydrologic cycle, the distinctions between natural events and human activities is becoming blurred.

Another limit on scope was that workplace issues were not within the direct scope of our analysis. Worker health and safety issues are considered to be a separate subject area outside the scope of the State of the Environment Report and not within the mandate or focus of Washington Environment 2010. Worker health is only included within the much broader scope of overall human health risks. Pollution within public buildings is within the scope of the indoor air pollution evaluation, and people can be affected by pollution within their work environment. Injuries from accidental releases are evaluated and transportation industry workers are included in the statistics on health effects. However, no special analyses have distinguished workplace risks from the evaluated risks to the general population. Risks that are specifically linked to occupational exposures (e.g. risks to pesticide applicators) are not addressed.

Washington Environment 2010
Figure 1
Scope of Resource Characterization and
Risk Evaluation for State of the Environment Report



* Includes outdoor & indoor air
** Includes fresh surface waters, ground water, & marine waters
***Includes forest lands, recreation lands, range lands, and agricultural lands.

A final broad limit on scope involves urban lands. Except for urban recreation lands, urban lands (i.e. developed land) are not separately characterized. Urban areas and their populations are affected by many of the threats evaluated and listed in Figure 1. Urban lands are fundamentally affected by the uses for which they were developed and characterization of urban lands as a separate resource was not undertaken.

The basic process followed by the Technical Advisory Committee relied as much as possible upon the members to assume responsibility for authorship of reports within the respective members' areas of expertise and normal work responsibilities. Responsibilities were thereby decentralized, with members designated with lead responsibility for specific resource characterization reports and risk evaluation reports. Designated lead authors were then assisted as necessary by 2010 program staff and, on occasion, by consultants under contract. Lead authors were also assisted by numerous contributors from the involved agencies. Initial discussion and review of work products was performed by Technical Advisory Committee subteams organized around specific groupings of threats (e.g. air quality related, water quality related, etc.) Also, Public Advisory Committee members sponsored a number of outside experts to review initial draft reports in subject areas in which they had particular interest. Subsequently the entire Public Advisory Committee and Steering Committee were invited to review and comment upon draft reports. The Technical Advisory Committee and the designated lead authors focused their efforts on characterizing the six resources and on evaluating the health and ecological risks of the 23 threats to those resources.

The evaluation of risk of economic damages for all threats was assigned to an outside consultant under contract to the Environmental Protection Agency. This was done both to spread the analytic workload and in recognition that the Technical Advisory Committee was composed of members who were specialists in their respective subject areas and could evaluate health and ecological risks, but were generally not expert in resource economics. The separation of health and ecological risk from economic damages risk evaluation and the relatively short timeframe to complete all the analyses and draft reports (i.e. less than six months) resulted in serious problems in integrating the economic damages report with the health and ecological risk reports. The economic damages report is attached as an appendix to Volume 3.

Although economic damages is an important consideration in determining overall priorities for environmental risk management, the report prepared for 2010 has serious limitation in terms of the information presented. These limitations relate to both the partial and imprecise nature of the quantification of economic damages contained in the report.

Not all of the economic damages for all of the threats are fully quantified. For those threats that were evaluated for economic damages, the report lists the different types of economic damages typically associated with the threat. In some cases, the economic

consultant was able to provide a dollar estimate for the majority of those damages (e.g., ambient air pollution). In most cases, however, only some of the economic damages associated with the threat have received dollar estimates (e.g., point and nonpoint source water pollution). And in some cases economic damages were not estimated at all (e.g., materials storage). These inconsistencies are usually a function of data problems - either not enough time to obtain the necessary information, or relevant information simply did not exist. Given the inconsistencies, the Technical Advisory Committee was concerned that the dollar estimates could be overemphasized while the economic damages not quantified could be unduly discounted. In many cases, economic damages were not quantified because information was not available, not because those damages were deemed negligible. In fact, in some cases the economic damages not quantified may equal or exceed those that are quantified, e.g., the omission of the loss of Indian fisheries from the analysis of the economic damages associated with hydrologic disruptions.

In addition to awareness of what is not in the economic report, caution should be used in evaluating the information that is in the report. The numbers included in this report represent imprecise estimates. Presentation of dollar estimates may convey more analytic precision than is justified. Economic damages risk analysis is inherently more of an art than it is a science. In some cases, for example, the analyses presented in the report are based on economic estimates taken from a single study, and/or from studies done outside the state of Washington. The wetlands analysis, for example, is based on a single economic valuation of wetlands in the state of Massachusetts. The value of Washington's wetlands might differ. In general, only cursory analysis was done of the economic studies on which these estimates are based, and on the specific applicability of those studies to Washington State.

Despite these flaws, the report is considered useful to help identify the types of economic damages associated with the different threats, and to give a very rough sense of the relative magnitude of those damages.

Completion of the State of the Environment Report with its constituent resource and risk reports, completed the work of the Technical Advisory Committee. The technical committee's work and resulting reports are incorporated into the broader Washington Environment 2010 Program. The information contained in these volumes has provided a basis for the Public Advisory Committee to refine its vision of the preferred future for Washington's environmental resources and a foundation from which to develop an action plan to ensure the creation of that preferred future.

III. Context

The State of the Environment Report was prepared within the broader context of the Washington Environment 2010 Program. Washington Environment 2010 is within a much broader context of related global issues and statewide issues and trends (e.g. population growth). Although this context of global and other statewide issues is largely beyond the scope of this State of the Environment Report, it is important to identify and acknowledge the significance of such issues. This context of global and statewide issues will be discussed in greater detail in a forthcoming Washington Environment 2010 report on the future vision for environmental resources, prepared under the auspices of the Public Advisory Committee.

In terms of global issues, early in its deliberations the Public Advisory Committee recognized the merit of the frequently used phrase, "think globally, act locally." The committee identified a list of 25 issues of global significance with which they were concerned and which could have significance to any environmental action plan for 2010. The committee further categorized these 25 issues as either being directly related to resource characterizations or risk evaluations within the scope of the State of the Environment Report (i.e. 14 of the 25 global issues) or, as not within the scope of the State of the Environment Report but with potentially significant relationships to planning the preferred future for Washington Environment 2010 (i.e. 11 of the 25 global issues). Figure 2 and 3 list these respective categories of global issues.

As even a cursory review of the listed global issues illustrates, Washington's environmental resources are linked to many issues that are global in nature. Although we can conduct analyses focused within Washington's borders, this state's environment both affects and is affected by many issues that are inherently global in scope.

There are also other statewide issues and trends which frame the context within which Washington Environment 2010 must develop. These statewide issues include: 1) projected state population growth, 2) economic development and employment outlook, 3) transportation needs, 4) energy sources and demand, 5) agricultural development, and 6) growth management. Each of these issues have interested constituencies and have generated governmental initiatives and planning activities. These statewide issues also involve major sectors of human activities that have significant relationships to environmental resources. It is essential that planning for environmental resources be integrated with the planned futures for these other sectors of human endeavor. Information available on trends or projections and existing plans for each of those sectors will be presented in more depth in the forthcoming report on the context and vision for Washington's future environment.

Figure 2. Global Issues Related to Subjects within the Scope of the State of the Environment Report

Global Issue	Related Reports within State of the Environment Report
Upper atmosphere ozone depletion	Air resource characterization Global warming and ozone depletion evaluation
Formation of ozone in lower atmosphere	Air resource characterization Ambient air pollution evaluation
Climate change and global warming	Global warming and ozone depletion evaluation
Diversity of fisheries and fisheries loss or extinction	Fisheries and shellfish resource characterization
Diversity of wildlife and wildlife loss or extinction	Fish and wildlife resource characterization
Sustainability of worldwide agriculture and food supply	Agricultural land resource characterization Nonchemical impacts on agricultural lands evaluation Nonchemical impacts on range lands evaluation
Deforestation	Forest land resource characterization Nonchemical impacts on forest land evaluation Global warming and ozone depletion evaluation
Desertification	Range land resource characterization Nonchemical impacts on range lands evaluation
Contamination of waters, including the oceans	Water resource characterization Point source discharges to water evaluation Nonpoint source discharges to water evaluation
Water availability	Water resource characterization Hydrologic disruptions evaluation Global warming and ozone depletion evaluation
Acid rain	Acid deposition evaluation

Figure 2. Cont'd.

Waste management	Active hazardous waste sites evaluation
	Inactive hazardous waste site evaluation
	Nonhazardous waste sites evaluation
	Radioactive releases evaluation
	Litter evaluation

Figure 3. Global Issues not within the Scope of the State of the Environment Report but Potentially Significant to Washington Environment 2010

World population increases
Cycles of economic development
International debt and budget and trade deficits
Transnational pollution
Energy supplies/availability
Minerals depletion
Unintended consequences of biotechnology or other technology
Coordination of international environmental research
Coordination of international environmental management strategies
Cost of global armaments
Global or regional nuclear war or incidents

The resource characterizations and risk evaluations contained in Volumes II and III of this State of the Environment Report did consider the available information on statewide trends and/or plans that were most relevant to that resource or risk (i.e. population, transportation, energy, etc.). When such information was relevant, it was used to make judgments about the future status of the resource or the expected trend of the risk. Highlights of the relationships between these other sectors and the projections for each environmental resource and patterns of effect upon environmental resources will be discussed in Sections V and VI.

Projected growth in population is a particularly significant factor in projecting environmental trends. Population projections by the Office of Financial Management (OFM) indicate that statewide population will grow by an estimated 1,448,253 persons from 1988 to 2010. This represents a statewide population increase of nearly 32 percent. Of this projected increase, 87 percent (i.e. over 1.2 million) is expected to occur in the 12 counties bordering Puget Sound. Population growth of over 1.1 million persons, or 78 percent of total statewide growth, is projected to occur in just five counties: King, Kitsap, Pierce, Snohomish, and Thurston.

During preparation of the resource characterization and risk evaluation reports, population projections, at the county level, were unavailable from OFM. The statewide population projection from OFM and unadjusted computations by 2010 staff based upon the statewide projection were used for county level projections. Recently OFM has projected adjusted county level population through 2010. The statewide population projection has remained constant. Population projections, including revised county level projections will be discussed in more detail in the forthcoming report on the context and vision for Washington's future environment.

IV. Specific Analytical Methodology

The overall analytical approach to preparing the State of the Environment Report integrated environmental resource characterization with comparative risk evaluation. Environmental resource characterization represents a standard planning method that establishes a baseline of information on the current status and trends of defined environmental resources. Comparative risk evaluation represents a more novel environmental planning method which entails using risk assessment principles to evaluate the comparative risks of defined environmental problems. It is important to note that even though, where possible, methods of quantitative risk assessment are used, comparative risk evaluation is a tool for environmental planning, not a scientific exercise. In this planning context, comparative risk evaluation is not intended to produce precise assessments of specific risks. Rather, it is only intended to support a roughly equivalent level of analyses that is sufficient for comparing defined threats to environmental resources and setting priorities for action. The intent is to improve and organize the information available to decision makers responsible for setting priorities. By integrating these two planning approaches, it is possible to evaluate the comparative risk of threats to specific environmental resources and to picture the comparative risks in the context of the current status and trends for each resource. Such integration of baseline resource information with risk evaluation also assists in projecting the future status of the resource if no additional actions to manage risk are taken.

As previously detailed in Figure 1, six environmental resources were defined for characterization and twenty-three threats to resources were selected for evaluation. Specific methods and ground rules for resource characterization and risk evaluation are outlined below. An overall ground rule was to use existing data. New monitoring or field data was not sought, though in many cases existing data was compiled, analyzed, or presented in new ways.

Resource Characterizations

The method for preparing resource characterizations is most simply described as the compilation and presentation of the best available descriptive information concerning each resource. Each characterization was intended to address the following points of information:

- A description of the current status of the resource
- The identification and characterization of trends discernible from historical data
- A description of existing resource management programs and particular resource management successes
- An acknowledgement and brief description of social benefits derived from use of the resource and particular opportunities to enhance the resource and/or the benefits derived from it
- A summary of the threats relevant to that resource and highlights of the risk evaluation results relevant to the resource

- A general characterization of the relationship to the resource of projected population growth or other projections of related activities (e.g. transportation, energy)
- A general description of the projected status of the resource in 2010, assuming no increase in authority or capability of resource management programs.

Risk Evaluations

As much as possible, the risk evaluations used methods and data consistent with standard risk assessment (i.e. hazard identification, dose/response data, exposure assessment, and overall risk characterization). Quantitative risk assessment has evolved to a relatively sophisticated methodology for human health risks, especially cancer risks. However, standard methods are not as highly developed for noncancer health risks, and even less developed for ecological or economic risks. Also, quantitative risk assessment is usually applied to more limited specific locations or chemicals. The statewide scale and broad scope of many of the evaluated threats, together with the limitations of available information, necessitated a more qualitative analysis in many cases, especially for ecological and economic risks.

In addition to use of best available information, two basic ground rules were applied to the risk evaluations. First, the intent was to evaluate "residual risk." Residual risk means the level of risk of actual and/or potential impacts remaining after considering the effect of current efforts to manage or reduce the risk. Second, each evaluation was to use similar or consistent methods to evaluate each type of risk posed by the threat (i.e. health, ecological, or economic). The consistency in methods for types of risk enhances the comparability of the analytic results.

Prior to conducting the risk evaluation, the scope of each threat was defined. Areas to be included or excluded were specified. Overlapping with other threat areas were identified so that "double-counting" of risks when comparisons were made would be recognized. The types of risk (i.e. human health, ecological, economic) that would be evaluated for each threat was also determined. Not all types of risk were considered relevant or significant for some threats. These scoping determinations are included in each evaluation.

For those threats where human health risks were evaluated, the approach addressed the following points of information:

- A description of the specific analytical approach taken based upon evaluation of available information on sources or risk, dose/response, exposure, documented health effects, etc.
- A quantified estimate and explanation of cancer risk, if applicable, to the maximum exposed individual (MEI)
- A quantified estimate and explanation of average cancer risk, if applicable, to the general population

- An estimate and explanation of any applicable chronic noncancer health effects risk to the MEI
- An estimate and explanation of any applicable chronic noncancer health effects risk to the general population
- Estimation or description of any documented acute health risks.

For those threats where ecological risks were evaluated, the approach addressed the following points of information:

- A description of the specific ecological risks (i.e. actual and/or potential impacts upon the value or function of a specific ecosystem) evaluated and the analytical approach taken based upon evaluation of available information on sources of risk, environmental pathways, receptors, documentation of impacts, etc.
- A qualitative description, with quantitative data where available, of ecological risk in terms of the following set of predetermined evaluation criteria:
  - Intensity of the impact upon ecosystem(s)
  - Geographic scope of the impact
  - Reversibility over time of the impact if the source or cause were to be removed
  - Sensitivity of the affected ecosystem(s)
  - Particular productivity or uniqueness of the affected ecosystem(s).

Economic damages risks were evaluated separately by a consultant on contract. For those threats where economic damage risks were evaluated, the approach was to create total estimates of quantifiable economic damages and to identify and qualitatively describe economic damages which were not quantifiable either because of a lack of information or lack of an accepted method to quantify the damage. Other "quality of life" values were not evaluated or identified. Examples include the intrinsic value of life, health, or "well-being", either human or otherwise. Severe time and financial constraints on the economic analysis resulted in significant limitations in the economic analysis and an inability to integrate the economic damages evaluations with the human health and ecological risk evaluations. The economic damages evaluations are included as an appendix to the other risk evaluation reports in Volume 3 of the State of the Environment Report. The limitations of this report are discussed in more detail on pages 6 and 7. Moreover, the Technical Advisory Committee and the individual risk evaluation authors considered the economic damage evaluation too incomplete to support a comparative evaluation (i.e. ranking) of economic damages risk.

In addition to evaluation of current residual risk, each risk evaluation included an evaluation of future trends in risk anticipated for each threat given any available projections for the sources or causes of the risk and the projected effect, in general terms, of existing risk controls or management programs. This analysis was focused on major changes or shifts in risk that can be anticipated given known conditions affecting either the creation or reduction of risk.

Finally, each risk evaluation characterized the level of uncertainty underlying the evaluation and any factors affecting the reliability of findings. Particularly significant gaps in information and critical assumptions are pointed out both to assist in comparing risks with differing levels of uncertainty and to help identify where additional information may be needed to further inform the priority setting process or determine appropriate actions.

V. Summary of Results

The complete set of resource characterization and risk evaluation reports are contained in Volumes II and III respectively of the State of the Environment Report. A complete and thorough reading of these reports is required to fully comprehend the bases for the analysis within the reports, the information available and unavailable for the reports, and the complete findings supported by the reports.

What follows is a brief summary of the results of the analyses organized by resource. For each resource, highlights of current status, trends, opportunities, key threats and risks, and projections to 2010 are presented. Following the highlights of results for each resource is a discussion of the Technical Advisory Committee and Public Advisory Committee comparative risk ranking process and the ranking results. Summary charts of the resources, threats, risks, rankings, and trends are also presented.

Air Resource

The air resource is essential for life, but it is easily taken for granted. In the past, it was treated as though it had unlimited capacity to absorb the emissions of human activities. Now it is understood that air emissions can create unhealthful levels of air pollution in the air breathed both indoors and outdoors. Air emissions can affect visibility on a cloudless day and are now believed by many scientists to affect the global climate.

Air quality has been monitored through a statewide network of air monitoring stations focused on the so-called criteria air pollutants: particulates, sulfur dioxide, carbon monoxide, volatile organics, lead, and nitrogen dioxide. This has resulted in a large body of information on the status and trends of air quality as measured by these pollutants. In terms of the large number of other air pollutants, particularly toxic air pollutants, much less is known because routine monitoring, until recently, was not conducted for these pollutants.

The levels of most monitored pollutants have declined over the last ten years. A number of areas, generally densely populated areas, still experience persistent air quality problems as measured by failure to attain health related national standards. Though most monitored sites have shown a decrease in air pollution concentrations over the last 10 years, the rate of decrease has generally dropped off in the last few years.

Apart from the most obvious benefits of clean air to healthful living, air quality also contributes to quality of life in other ways. In Washington particularly, the recreational and other economic values of clear vistas and views of the mountains and other natural resources is of incalculable value. Also, clean air is a powerful magnet for economic development that values the quality of life in an area. Ironically, the very quality of life factors, including clean air, that can attract additional development and

residents, can also be jeopardized by the additional vehicles, woodstoves, and other emission sources that such development brings.

On the positive side, existing air pollution control programs have been quite successful in reducing certain pollutants. Controls on lead in gasoline and on point sources that emit significant amounts of lead have brought about compliance with standards for this toxic pollutant. Controls on fluoride emissions from aluminum smelters and sulfur dioxide emissions from pulp and paper mills are another success story. Controls on motor vehicle emissions have significantly reduced violations of carbon monoxide standards in Seattle, but other areas of the state (e.g. Bellevue) are not doing as well.

Ambient and indoor air pollutants emitted from a variety of sources constitute the major threats to the air resource and involve significant health, ecological, and economic risks. Toxic contaminants in indoor and outdoor air pose relatively high cancer risks to exposed populations, relative to other threats evaluated. Much of Washington's population is at risk of chronic noncancer health effects (e.g. respiratory distress, headache) from criteria air pollutants. Trees which are sensitive to ozone may experience various types of effects from currently monitored ozone levels. The state's ecosystems may experience a wide variety of impacts from climate changes brought about by global warming due to emissions of carbon dioxide and other greenhouse gases.

The major sources of ambient air pollution in Washington include motor vehicle emissions, woodburning (woodstoves, wood-fired boilers, timber slash burning), vehicle refueling emissions, pulp mills, aluminum smelters, and agricultural burning. Major sources of indoor pollution include tobacco smoke, transport of outdoor pollutants, fumes from building materials, household chemical use, and inadequate ventilation.

For the future, as the population increases, and in the absence of additional air pollution controls, air quality will decline. The intensity and frequency with which health-based standards are exceeded will increase, and areas currently near but not exceeding standards will likely soon do so. Overall, concentrations of pollutants in the ambient air are projected to increase by an average of nearly 25% by 2010. Although this future picture of the air resource is gloomy, it may be overly pessimistic. This projection assumes no improvements over existing levels of control or management of emissions to the air resource between now and 2010. Given that air pollution prevention and air resource management is in many ways in its infancy, impressive improvements in technology and management may be made as these efforts continue to mature.

Water Resource

Washington is fortunate to have an abundance of water resources including the marine waters of coastal, estuarine, and inland waterways, the surface rivers and streams of the Columbia, Puget Sound, and coastal basins, and an extensive network of groundwater

aquifers. These waters support a variety of beneficial uses including public water supply, irrigation, industrial water supply, recreation, and habitat for fisheries, shellfish, and other life.

Water quality is evaluated based upon available monitoring data that is used to indicate whether the quality of specific bodies of water will support its beneficial uses. Adequate monitoring data is generally available for only fractions of the types of water resources (i.e. groundwater, marine water, surface streams, lakes). Although data is limited, groundwater contamination may be more widespread than previously believed. Groundwater contamination is of particular significance because more than half the state's population relies on groundwater for drinking water. Groundwater also contributes flow to streams, lakes, and wetlands and thus may affect the quality of these water bodies as well. All of the state's open coastal waters are supporting their beneficial uses. However, in estuaries such as Puget Sound, Grays Harbor, Willapa Bay, and the Columbia River, water quality problems from human activities are affecting beneficial uses in substantial areas of those waters. Although monitoring data is available to assess only a small fraction (11%) of the state's surface waters, about half the stream miles assessed are either threatened or are not supporting their beneficial uses. Most of the assessed lake water acreage in Washington is supporting beneficial uses, although many lakes are experiencing elevated nutrient loading from lakeside development and Roosevelt Lake in eastern Washington is experiencing metals contamination apparently from upstream mining operations. The state's waters, of whatever type, are characterized as not supporting their beneficial uses if they are either impaired or threatened with becoming impaired in terms of meeting statutory goals and established water quality standards.

The availability of water to support beneficial uses is another significant concern. Groundwater primarily supports both drinking water and irrigation needs. Surface water flows support both consumptive and nonconsumptive diversions of water for potable water supply, irrigation, and hydropower generation and instream flow needs for hydropower generation, aquatic and wildlife habitats, and recreation. In many areas of the state, groundwaters and surface waters have reached or will soon reach a level of water appropriation where additional withdrawals for any use will affect either hydropower generation capabilities or fisheries and wildlife habitat, or other existing water rights. Although Washington has not had a very active market in sale or transfer of water rights, this could change as the limited availability of unappropriated or unreserved water for new development is more widely recognized.

Deficiencies in the data base for water quality makes it impossible to clearly delineate overall historic trends to this point, however some successes are evident. South Puget Sound point source controls have allowed the restoration of the Olympia oyster into historical habitat areas. Lake Washington water quality has improved dramatically over the last 20 years as sewage flows previously entering the lake were intercepted. The Columbia River has experienced reduced algae blooms as treatment requirements have reduced the nutrients reaching the river.

Key threats to the water resource include a variety of point and nonpoint discharges to waters and various types of disruptions to the hydrology of water systems. The principal health risks relate to the contamination of surface or ground waters used for drinking water and the contamination of fish or shellfish used as food. Ecological risks include contamination of habitats and stress on aquatic organisms from pollutants and loss of habitat or stress on remaining habitat from overappropriation of waters or other changes to stream flow. Principal sources of pollutants include industrial and municipal wastewater discharges, urban stormwater, agricultural runoff, waste disposal sites, hydrologic modifications, and accidental releases of chemicals and oil products. The effects of ambient air pollution on the biologically active microlayer of marine and estuarine waters is also emerging as a concern. Major out-of-stream water uses include municipal, commercial, industrial, and domestic water supply, irrigation, hydroelectric power generation, and upland aquaculture. Over the longer term, climate change is looming as a potential major impact upon water resources; from the effects of sea level and temperature rise to substantial changes in frequency, duration, and nature of precipitation and resulting runoff patterns.

Given projected population growth and assuming only current levels of resource management, in 2010 there will be significant increased stress on water resources in the more densely populated areas of the state. Groundwater will be more heavily utilized and groundwater contamination will be a more critical issue. Surface waters, lakes, and Puget Sound will be adversely affected by the large number of nonpoint sources of contaminants associated with population growth in western Washington. Municipal water utilities will continue to develop ground water resources and will propose new surface water diversions and reservoirs. With the exception of its susceptibility to oil spills from transportation accidents or possible oil drilling mishaps, the ocean coastal waters are expected to be maintained over the next twenty years, since much of the coast is preserved for recreation and most population growth occurs elsewhere. With less population growth and with improvements in farming practices eastern Washington may not experience as severe a deterioration of water resources. However, competition among current and potential water uses, including instream habitat maintenance, is expected to intensify. Throughout the state, increased demand for electrical energy may result in increased emphasis on proposals for new, small hydropower projects.

Land Resource--Forest Lands

Forested lands comprise approximately 50% of Washington's land base. This land supports recreation, wildlife, and timber resources. Over 17 million acres of the state's forest lands are characterized as commercial timber lands, in private, state, and federal ownership. There is a wide diversity of climate, topography, and soils that have resulted in diverse forest ecosystems in Washington.

The forest land base and the amount of commercial forest land continues to decline. In the period between 1930 to the present, over 4 million acres of commercial forest lands were converted to nonforestry uses and the amount of old growth forests declined from 11 million acres to about 4 million acres. Another indication of the current status of forest land is the rate of soil erosion, which appears to be decreasing largely as a result of improved management and increased regulation over the past 50 years.

Forested lands support the timber products industry in Washington and are a principal mainstay of the local economy in many areas of the state. Forested lands also provide extensive recreational opportunities which support another significant sector of the state's economy. Forests provide a variety of habitats for wildlife and old growth forests support biologically diverse ecosystems that are of special significance for education, research, and other uses.

Particular potential for success in forest land management is represented by the Timber/Fish/Wildlife Agreement (TFW). TFW emphasizes reaching consensus in arriving at solutions for forest management issues and has resulted in significant advances in the regulation of the impacts of timber harvest practices upon forest resources including benefits to wildlife, fisheries, timber resources, and archeological concerns. The development of draft and final forest management plans by the U.S. Forest Service and various efforts to reconcile competing claims upon use of old growth forests represent further opportunities to enhance the variety of benefits derived from the forest land resource.

The primary risks to the forest land resource are attributable to: 1) conversion of forest lands to nonforest uses, 2) conversion of old growth to second growth forest, 3) nontimber uses of forest land, and 4) timber harvest practices on forest land. The U.S. Forest Service estimates commercial forest land will decline by about 1 million acres (50,000 acres per year) over the next 20 years. Residential and other types of land development will contribute to this decline as will road right-of-ways, buffer strips, and forest preserves. Conversion of old growth forests to second growth forest reduces habitat and other values represented by the old growth ecosystem. Nontimber uses of forest land, particularly intense recreational uses, can compact soils, affect vegetation, and otherwise disrupt the forest ecosystem. Timber harvest impacts upon forest lands include effects of roadbuilding, soil compaction and displacement, changes in soil chemistry, and reduction in ecosystem species diversity.

Secondary and potentially significant risks to the resource are posed by temperature and precipitation changes due to global warming, ozone impacts to sensitive tree species due to ambient air pollution, and stress to pH sensitive species due to acid deposition in forested areas.

Increased population and global demand for forest products will result in increased competitive demands upon forest land resources by 2010. Impacts of population growth will be most acute where forest lands are used for recreation, and overall recreational use of forest lands will be much greater. Due to urban development and conversion of forest lands, the total forest land available for commercial timber harvest will decline. The total of old growth forests will also decline. Timber harvest levels will remain between 4 and 7 billion board feet per year.

Land Resource--Recreation Lands

Lands designated and managed for outdoor recreation in Washington are found in a variety of settings and are as diverse as the state's geography. These recreational lands total over 7.7 million acres and are comprised of urban/rural areas, roaded natural areas, semi-primitive areas, and primitive areas, which are the categories of lands characterized in the Recreational Opportunity Spectrum.

These diverse lands support an equally diverse array of recreational opportunities that are important to both Washington residents and visitors. Recreation and associated service industries are a significant contributor to the state's economy.

Several state and federal agencies have been instrumental in providing and managing existing recreational lands and associated recreational opportunities. The Interagency Committee for Outdoor Recreation has distributed state and federal funds to support urban/rural recreation projects and recreational land acquisition. The Parks and Recreation Commission manages the state parks system and the Department of Natural Resources manages state lands for recreation as well as other uses. The National Park Service and U.S. Forest Service manage large tracts of federal lands used for recreation.

Key threats to the recreational land resource are resource extraction and associated road building, overuse, misuse, and urbanization and development. The potential effects from these threats are loss of habitat and environmental degradation which includes sanitation problems, water contamination, destruction of vegetation, and disruption of wildlife. Other risks to the resource include loss of scenic vistas due to air pollution, impacts upon alpine lakes from acid deposition, and coastal recreation impacts from sea level rise due to global warming.

Interactions between both the supply and demand sides of the recreational equation are expected to intensify in the future. Population increases and associated development and economic activity are expected to increase risks posed by resource extraction, overuse, and urbanization. Therefore, the supply or quality of recreational land will be under increased pressure at the same time as demand for land based recreational opportunities increases significantly. Unless the supply of recreational opportunities is expanded, more overuse and deterioration of recreational lands can be expected. At the same time, urbanization will create pressure to

convert existing open spaces used for recreation to other uses as well as driving up the price of acquiring land for recreational uses. The demands of users grow but the supply of land may remain the same. Unless dramatic changes are made, recreational acreage and quality is not expected to begin to keep pace with the rate of population growth.

Land Resource--Rangelands

The rangeland resource includes three types of grazing land; pastureland, grazable forest land, and rangeland. Washington has approximately 1.0 million acres of pastureland, 5.5 million acres of grazable forest land, and 6.0 million acres of rangeland. The rangeland is all east of the Cascade Mountains.

Successional stages of plant communities (i.e. climax, late seral, middle seral, early seral) are used by the Soil Conservation Service and the Bureau of Land Management to evaluate the condition of rangelands. The latest evaluation in 1984 rated 67% of rangelands in fair or poor condition. Grazable forest lands are rated on the basis of forage value, with 65% of these lands with less than acceptable production values for forage. However, there is a direct tradeoff between forage value in the grazable understory of vegetation and the forest value of the overstory of trees. Evaluations of pastureland, albeit based on a small sample, found that 72 percent of pastures fell into only fair or poor categories. These evaluations are reported in "Washington State Grazing Land Assessment," prepared by the Washington Rangeland Committee and the Washington Conservation Commission.

Washington benefits from rangeland in terms of its contribution to agricultural production. Washington stockmen depend upon low cost range forage to keep them competitive with livestock producers from other areas. Range also provides significant wildlife habitat and is an aesthetic resource in its own right; a unique and fragile ecosystem with intrinsic values.

Rangelands are largely managed by the U.S. Forest Service and the Bureau of Land Management.

The principal threats to rangeland, evidenced by the reduced quality of these lands, are overgrazing and infestation by noxious weeds. Overgrazing is the attributed cause of the fair or poor rating of over 3.5 million acres of grazeable land. Inundation by noxious weeds is the cause of a fair or poor rating for approximately 560,000 acres. These effects are reversible, but rangeland restoration is a long term proposition, requiring decades in most places.

In the future, direct impacts upon rangeland resources may not increase as much as for other resources, because population is not expected to increase in most rangeland areas. However, an increasing population's demand for agricultural products may result in increased pressures to allow grazing which the rangelands cannot sustain without increasing damage.

Land Resource--Agricultural Lands

The focus of the agricultural land resource characterization is upon the 7.8 million acres of cropland in the state. Washington currently supports approximately 38,000 farms with 16.0 million acres of land. About half this land is in pasture, range, and woodlands. After declining in the previous decades, the number of farms and farm acreage has remained relatively stable in Washington in the 1980s. Two sets of information provide indicators of the current status of agricultural lands; agricultural production and condition of cropland soils. Accurate and thorough information on agricultural production indicates that Washington is a leading producer of many commodities and that agricultural land productivity, although varying, has been high. However, agricultural productivity is an imperfect indicator of the condition of agricultural lands because so many other factors affect agricultural production values (i.e. farm policy, economic conditions, weather). Production value does not necessarily capture the long term capabilities of the agricultural land. The Soil Conservation Service (SCS) has characterized Washington cropland soils according to their suitability for frequent cultivation. According to this classification, 5.2 million acres of Washington's cropland are suitable for frequent cultivation, 2.1 million acres are marginal, and approximately 500,000 acres are unsuitable for cultivation. An examination of soil erosion rates shows that most eastern Washington counties are experiencing erosion rates well above the generally acceptable rate of 5 tons/acre/year.

Beyond the obvious and significant benefit of producing food for a hungry world, Washington agricultural lands support a vibrant farm economy that is a mainstay of the statewide economy and of local economies throughout the state. Agricultural lands support the family farmer and much of rural Washington's social structure.

The principal threats to agricultural lands are conversion to other uses and erosion. An estimated 23,000 acres per year of agricultural lands are converted to other uses, primarily urban related development. Most of these acres are prime farmland in close proximity to developing areas. Some of these acres are marginal, highly erodible, and are thus taken out of agricultural production.

Erosion poses a serious threat to Washington's croplands. Excessive erosion above 5 tons/acre/year occurs in much of eastern Washington. Erosion depletes soil fertility and water retention capacity, and topsoil loss eventually leads to decreased production capacity. Although the Conservation Reserve Program (CRP) of SCS is intended to take the most vulnerable, erodible land out of production, some farmers can earn more income by continuing to farm their CRP-eligible land. Loss in cropland productivity, sedimentation, water pollution, increased chemical use, and loss of fishery habitat are some of the long-term consequences and costs associated with erosion. Conservation practices are designed to reduce these effects. Many on-farm conservation practices, such as conservation tillage, have a positive economic effect at the farm level. Other practices require

that the larger social costs of erosion be considered before the practice is economically feasible. Some conservation practices can only be considered and implemented when social values other than short-term economics are of overriding importance.

Less understood but potentially significant threats to agricultural lands are posed by ambient air pollution, particularly ozone, and global warming and ozone depletion. Ozone can cause plant damage but the current distribution of elevated ozone levels in Washington suggest that most agricultural lands will not be affected. The implications of global warming and ozone depletion for agriculture are not well understood. On the one hand, some crops respond positively to elevated carbon dioxide levels. However, this is likely to be offset by adverse effects from upper atmosphere ozone depletion and by potential effects upon water resources.

Population growth will create increasing demands and opportunities for production from agricultural lands. Agricultural lands will also come under increasing pressure to convert to other uses in urbanizing areas. Marginal agricultural lands may be brought into cultivation to satisfy increasing markets for agricultural products. Agricultural technologies will be challenged to maintain or increase production while maintaining the longer term sustainability of agricultural lands and reducing the impacts of farm practices upon other resources.

Wetlands Resource

Although more comprehensive information on the wetlands resource is being developed, currently available information indicates that 938,000 acres of wetland remain throughout Washington from an original inventory prior to settlement of approximately 1.5 million acres. Reliable information is not available to describe the condition or quality of Washington's remaining wetlands, although wetland managers express great concern over the ongoing degradation of wetland quality. The estimated range of the rate of loss of wetlands is a continuing trend of between 700 and 2000 acres per year.

Wetlands have assumed more prominence in recent years as the benefits derived from wetlands have become understood. Wetlands benefits include: providing critical habitat for fisheries and wildlife, supporting various types of recreation, providing groundwater recharge and discharge, improving water quality through natural treatment of sediments and nutrients, flood storage, and shoreline support and dissipation of erosive forces.

No comprehensive evaluation of methods to preserve or protect Washington's wetlands has been conducted, but full acquisition, acquisition of conservation easements, mitigation of wetland's impacts during development projects, and other landowner incentive programs have shown usefulness. Current programs under the federal Clean Water Act are incomplete in their jurisdiction and have not yet been effective in preventing wetlands loss.

The principal threat to wetlands is their loss through drainage, dredging, filling, or otherwise disrupting wetland hydrology in relation to urban, agricultural, or silvicultural development. Point and nonpoint discharges of pollutants and sediments caused by land disturbing activities contribute to degradation and more gradual loss of wetlands. Future sea level rise due to global warming could have a devastating effect upon coastal and estuarine wetlands at some point in the next century. Wetlands have been artificially created, particularly in eastern Washington, as a byproduct of irrigation. New efforts to improve the efficiency of irrigation water use could alter the hydrology that currently supports these wetland areas.

Given population growth and development pressures, wetlands losses are anticipated to continue at the current estimated rate of between 700 and 2000 acres per year in the absence of more comprehensive protection programs or funding to carry out acquisition or protection. By 2010, an additional 14,700-42,000 acres will be lost. Degradation due to pollution, introduction of undesirable plant species, peripheral habitat loss, and other factors is likely to continue or increase as well. Global warming and associated sea level rise impacts on wetlands are not projected to actually occur until after 2010.

Fisheries and Shellfish Resource

The fisheries and shellfish resources included in the resource characterization report are those managed by the Washington Department of Fisheries (WDF). WDF is mandated to manage the foodfish and shellfish resources in state waters. These resources consist of five species of Pacific salmon, numerous species and types of shellfish, and other species of marine baitfish, flat fish, and ground fish. To manage these resources, WDF measures the condition of each resource and determines the surplus available for harvest without damaging the basic stock. WDF then sets fishing seasons and regulations.

The Pacific salmon resource is relatively stable statewide. Using commercial harvest as an index, salmon stocks are remaining stable or improving. Except for razor clams which have been severely affected by virus and beach closures due to pollution or red tide, most shellfish resources are showing strong and relatively stable or increasing production. Dungeness crab populations have been fluctuating in recent years and may be poised for a decline. Ocean pink shrimp have also shown a decline in catch per unit of effort in recent years. Production of other marine fish in Puget Sound show declines in various areas for a number of species, in particular, pacific herring. Coastal marine fish resources are generally healthy.

Trends for fisheries and shellfish resources are highly variable depending upon the specific species and geographic area. The benefits of healthy fisheries and shellfish resources for both those within the industry and for those who enjoy this bounty from the sea are obvious. Both new technologies, such as salmon rearing

net pens, and new management initiatives, such as international treaties on commercial fishing, are significant variables in maintaining fisheries and shellfish resources.

WDF uses many tools to ensure stocks of food fish and shellfish and their habitats are maintained or enhanced. These include fishery regulations, laws to protect habitat, and enforcement. WDF policy is to achieve a net gain in the productive capacity of habitat through protection of existing habitat, rehabilitation of habitats damaged by natural or human causes, and enhancements to improve existing habitat or create new habitat. Examples of successes using these tools include fish passage improvements at dams, fishway and screening projects, and protection of specific habitats through administration of the state Hydraulic Code, the State Environmental Policy Act, and the Timber/Fish/Wildlife agreement.

The principal threats to the fisheries and shellfish resource that were evaluated are point and nonpoint discharges of pollutants to water and hydrologic disruptions that impact stream habitats. Pollutant discharges have led to contamination and disease in fish and shellfish, particularly in urban streams and urban embayments. Contamination of fish and shellfish tissue has been severe enough to cause closures of shellfish beds and issuance of advisories against eating fish from particular locations.

A variety of human activities in watersheds or wetlands supporting fisheries and shellfish resources can adversely impact habitat by changing water temperature, causing increased sedimentation, or disrupting or reducing instream flows. The specter of global warming and ozone depletion are also significant threats to the future of fisheries and shellfish resources. Increases in ocean temperatures may change the habitat range for temperature sensitive species such as halibut, pacific cod, pink and chum salmon, and razor clams to the point that these species and others could disappear from Washington waters. Other changes in water temperature or flow could affect marine and freshwater food chains. Ozone depletion and resulting increases in ultraviolet light may have adverse effects upon phytoplankton and other microorganisms that are critical in aquatic food chains.

Increased human population will create increased stress on and competition for fisheries and shellfish resources. Increased population threatens habitat degradation for anadromous fish. Of particular concern are water quality degradation due to urban runoff and spawning ground loss due to disruption of streams in urbanizing areas. Population increases result in habitat loss which results in reduced natural propagation of fish and shellfish resources. The only way to increase or maintain the resource will be to enhance existing habitat and/or restore habitat lost to dams and other obstructions and increase production through fish and shellfish hatchery programs.

Fish and Wildlife Resource

The Washington Department of Wildlife (WDW) has management responsibility for approximately 500 species of fish and wildlife. To provide a characterization of these resources, they are presented in the report as eight separate groups (Resident Fish, Warmwater Fish, Anadromous Fish, Big Game, Migratory Game, Furbearers, Upland Game and Nongame). These groups were selected because they reflect agency program organization.

Resident fish (trout, char and landlocked salmon) are present in nearly all streams and about 650 of the state's 5,000 lowland lakes and 1,200 of the alpine lakes. Warmwater fish (sunfish, catfish, perch, pike and bass families) are present in about 90 percent of the lowland lakes. Anadromous fish (sea-run Dolly Varden, cutthroat and steelhead trout) occur in the majority of the streams and rivers. Big game (deer, elk, bear, cougar, bighorn sheep, moose and mountain goat) occur statewide wherever remaining habitat permits. Furbearers (raccoon, beaver, muskrat and skunk, among others) are also broadly distributed with higher concentrations associated with riparian areas and wetlands. Migratory game (ducks, geese, swans, coot, snipe, band-tailed pigeons and mourning doves) includes about 40 species which are distributed statewide by habitat requirements of individual species. Upland game (grouse, pheasants, quail, partridges, turkeys, rabbits and others) are also variously distributed throughout the state. Nongame (approximately 400 species) are distributed throughout the state according to habitat needs and availability. Some are widely distributed while others occur only in isolated areas.

Statewide estimates of the current numbers of most fish and wildlife groups, though there are exceptions, are generally not available. Numbers are available in many cases, however, based on specific geographic area or species. The following are some examples. Currently, there are about 525,000 returning, adult steelhead per year (combined summer and winter runs). There are about 200,000 black-tailed deer, 67,000 white-tailed deer, and 135,000 mule deer. Elk herds total about 57,000; bear 19,000; and cougar 1,500. Wintering waterfowl total about one million and production levels are about 600,000 annually.

In very recent years, numbers of species in most groups have remained fairly stable, but there are examples both of losses and gains. Over a longer time span, however, numbers in most groups show definite declines. Some examples follow. Prior to hydropower, navigation, and irrigation development, the Columbia River alone supported about 550,000 steelhead. Since 1960, deer populations have declined by 50,000 for black-tailed, 15,000 for mule deer, but white-tailed numbers have increased by 17,000. Elk have increased moderately since 1960, bear have declined by about 10,000, and cougar numbers have increased by 900. Peak waterfowl harvests have dropped from 800,000 to 300,000 in 1987 though numbers may again be increasing.

The benefits derived from the fish and wildlife resource include a variety of recreational oportunities, the ecological function of each species, education and research values, and the intrinsic value of each species' existence.

The key threats to the majority of the species within the eight basic groups of fish and wildlife include; threats which impact agriculture, recreation, range and forest lands, hydrologic disruptions, wetland degradation/loss, and pesticides. The major risk to the state's fish and wildlife can be summed up as habitat loss or alteration. If, for example, agricultural lands are lost to urban development, there will be losses to upland birds such as pheasant. Losses in riparian and wetland areas will reduce numbers of waterfowl, nongame, furbearers and fish. Many nongame species are grouped by special habitats (shrub/steppe, old growth, meadow/prairies and juniper forest, among others). Loss or alteration of these habitats is critical to the wide variety of species that depends on them. Fish and wildlife resources are also threatened by accidental releases such as oil spills or point discharges and nonpoint pollution. Habitat loss, however, is considered to be the most significant threat of all.

It is certain that the overall habitat base will continue to decrease and that an increasing human population will place increasing recreational demands upon remaining fish and wildlife populations. It is uncertain what the rate of loss will be. In light of this, it is expected that the vast majority of species will decline in numbers. Existing numbers, even of priority game management species, will be extremely difficult to maintain. WDW estimates that approximately 11 nongame species will be extirpated from the state by the year 2010.

Risk Evaluation Results

After completing and reviewing the risk evaluation reports for all 23 threats to resources, the Technical Advisory Committee undertook a process to evaluate the comparative magnitude of these threats in terms of risks to human health, to ecological systems, and for economic damages. The committee members briefed each other on their findings, prepared worksheets summarizing and comparing these findings, completed individual rankings, and then worked through group discussion to build a consensus on the comparative ranking of these risks. A consensus was reached for a comparative ranking of health risks and for ecological risks, but not for risk of economic damages. The consensus reached for health and ecological risks was to rank the threats based on the average score from the individual member's rankings. Further consensus was reached on different levels of risk that distinguished different groupings of threats from the others. In other words, threats grouped in the highest level of risk were more distinguishable in terms of comparative risk from the next lower group than the threats within each level were from each other. Threats with health risks were grouped in four distinct levels (i.e. higher, medium high, medium, lower). Threats with ecological risks were grouped in three distinct levels (i.e. high, medium, lower).

The Technical Advisory Committee also reached consensus on not ranking threats in terms of risk of economic damages. The committee had serious reservations about the adequacy of the information base. Given the incompleteness of quantified economic damages information and the scope and unevenness of economic damages that were not quantified, the committee was unwilling to make comparative evaluations or rankings. Technical Advisory Committee members were chosen to serve on the committee on the basis of their expertise in matters directly related to the threats being studied and the evaluation of health and ecological risks. Members were thus prepared to offer their professional judgments to assist the Public Advisory Committee when making comparisons in these areas. Most members did not have special expertise in resource economics and were unwilling to offer comparative judgments without more complete or compelling information.

Concurrent with the Technical Advisory Committee's ranking of health and ecological risks, a separate committee of state agency policy analysts and program managers developed an additional report characterizing other factors relevant to the management of risk for each of the 23 threats. Those risk "controllability" factors included: legal authority, evidence of public concern, availability and effectiveness of control technologies or management techniques, and adequacy of current programs. Each factor was briefly described and rated for each threat. This report to the Public Advisory Committee is attached to Volume I as Appendix A.

At a series of meetings in June and July, the Public Advisory Committee was briefed on the health and ecological risk evaluation reports, the economic damages report, resource characterization reports, and the risk controllability report. The committee was also provided a briefing on the results of the Technical Advisory Committee's ranking of health and ecological risks. The Public Advisory Committee members were provided a ranking worksheet and asked to submit their individual ranking of the overall risk management priority of the 23 threats. These individual rankings were compiled and formed the initial basis for discussion by the committee.

On August 29 and 30, 1989, the Public Advisory Committee met to evaluate the comparative priority for risk management of the 23 threats to environmental resources. After lengthy deliberation, the Public Advisory Committee produced a comparative ranking of overall risk management priorities. In the ranking process, the Public Advisory Committee included consideration of economic damages in its overall ranking based upon the individual member's judgment and expertise. The 23 threats were grouped into five different priority levels. Each priority level is considered distinguishable from the next, but threats within priority levels are not ranked. While this priority level ranking indicates which threats are considered by the Public Advisory Committee to have higher risk management priority than others, it does not suggest that any of the threats are insignificant. Labels, such as high/medium/low, were not given to the priority levels precisely

because all of the threats are considered important. For example, litter, which is in the lowest ranked category, includes issues such as hypodermic needle and other medical waste, and beach and marine litter that are considered significant.

The Public Advisory Committee considered the following points significant to understanding the results:

- These are overall management priorities considering the combination of an array of relevant factors (i.e. health risk, ecological risk, economic risk, trends, controllability, personal judgments, etc.).

- The adequacy of existing programs was a particularly influential "controllability" factor in determining rankings. This is consistent with considering the actual residual risk which remains after factoring in existing risk management programs.

- All threats merit consideration, but the ranking provides guidance in choosing between threats for their priority for management attention.

- The priority rankings represent a consensus of the Public Advisory Committee.

- The priority rankings reflect a statewide perspective and do not necessarily reflect more localized priorities.

- The rankings of threats related to nonchemical impacts on the various land categories (i.e. forest, agricultural, recreation, range) does not fully capture the overall significance of land use issues. Land use issues are often framed in terms of land use benefits and opportunities rather than in terms of risk to the land.

- The priority rankings are a key component of Washington Environment 2010, but represent just <u>one</u> of several building blocks for an action plan.

The environmental resources and threats relevant to those resources are summarized in Table 1. Table 1 lists the threats that are of significant relevance to each environmental resource and it shows the types of risk evaluated, the anticipated trend of evaluated risks, and the overall risk management priority of each threat as evaluated by the Public Advisory Committee. Table 2 is a list of the 23 threats showing their priority levels. Table 3 is a more detailed list which includes the key points of rationale for the rank of each threat as discussed by the Public Advisory Committee.

Table 1. Summary of Threats and Risks to Environmental Resources

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Air	Ambient air pollution	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Indoor air pollution	3	Health	Stable
			Economic	Increasing
	Radioactive releases	4	Health	Decreasing
			Ecological	Decreasing
			Economic	Decreasing
	Indoor radon	4	Health	Stable
			Economic	Stable
	Nonionizing radiation	5	Health	Increasing
			Ecological	Increasing
	Global warming and ozone depletion	3	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Regulated hazardous waste sites	3	Health	Decreasing
			Ecological	Stable
			Economic	Stable
	Uncontrolled hazardous waste sites	2	Health	Decreasing
			Ecological	Decreasing
			Economic	Decreasing
	Nonhazardous waste sites	3	Health	Not estimated
			Ecological	Not estimated
			Economic	Decreasing
	Materials storage	5	Health	Decreasing
			Ecological	Decreasing

Table 1. Cont'd.

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Air Contd.	Sudden and accidental releases	4	Health	Uncertain
			Ecological	Uncertain
			Economic	Stable
	Pesticides	3	Health	Uncertain
			Ecological	Uncertain
Water	Ambient air pollution	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Radioactive releases	4	Health	Decreasing
			Ecological	Decreasing
			Economic	Decreasing
	Global warming and ozone depletion	3	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Point source discharges to water	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Nonpoint source discharges to water	1	Health	Increasing
			Ecological	Stable
			Economic	Increasing
	Drinking water contamination	2	Health	Increasing
	Acid deposition	4	Ecological	Stable
	Hydrologic disruptions	3	Ecological	Increasing
			Economic	Stable
	Regulated hazardous waste sites	3	Health	Decreasing
			Ecological	Stable
			Economic	Stable

Table 1. Cont'd.

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Water Contd.	Uncontrolled hazardous waste sites	2	Health	Decreasing
			Ecological	Decreasing
			Economic	Decreasing
	Nonhazardous waste sites	3	Health	Not estimated
			Ecological	Not estimated
			Economic	Decreasing
	Materials storage	5	Health	Decreasing
			Ecological	Decreasing
	Sudden and accidental releases	4	Health	Uncertain
			Ecological	Uncertain
			Economic	Stable
	Litter	5	Health	Not estimated
			Ecological	Not estimated
Land-Forest Lands	Ambient air pollution	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Global warming and ozone depletion	3	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Acid deposition	4	Ecological	Stable
	Nonchemical impacts on forest lands	2	Ecological	Stable
			Economic	Increasing
Land-Recreational Lands	Ambient air pollution	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing

Table 1. Cont'd.

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Land-Recreational Lands Contd.	Global warming and ozone depletion	3	Health Ecological Economic	Increasing Increasing Increasing
	Acid deposition	4	Ecological	Stable
	Litter	5	Health Ecological	Not estimated Not estimated
	Nonchemical impacts on recreation lands	3	Ecological Economic	Increasing Increasing
Land-Range Lands	Nonchemical impacts on range lands	4	Ecological Economic	Increasing Increasing
Land-Agricultural Lands	Ambient air pollution	1	Health Ecological Economic	Increasing Increasing Increasing
	Global warming and ozone depletion	3	Health Ecological Economic	Increasing Increasing Increasing
	Nonchemical impacts on agricultural lands	2	Ecological Economic	Increasing Decreasing
Wetlands	Ambient air pollution	1	Health Ecological Economic	Increasing Increasing Increasing
	Global warming and ozone depletion	3	Health Ecological Economic	Increasing Increasing Increasing

Table 1. Cont'd.

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Wetlands Contd.	Point source discharges to water	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Nonpoint source discharges to water	1	Health	Increasing
			Ecological	Stable
			Economic	Increasing
	Hydrologic disruptions	3	Ecological	Increasing
			Economic	Stable
	Uncontrolled hazardous waste sites	2	Health	Decreasing
			Ecological	Decreasing
			Economic	Decreasing
	Nonhazardous waste sites	3	Health	Not estimated
			Ecological	Not estimated
			Economic	Decreasing
	Sudden and accidental releases	4	Health	Uncertain
			Ecological	Uncertain
			Economic	Stable
	Wetlands loss/degradation	2	Ecological	Increasing
			Economic	Increasing
Fisheries and Shellfish	Radioactive releases	4	Health	Decreasing
			Ecological	Decreasing
			Economic	Decreasing
	Global warming and ozone depletion	3	Health	Increasing
			Ecological	Increasing
			Economic	Increasing
	Point source discharges to water	1	Health	Increasing
			Ecological	Increasing
			Economic	Increasing

Table 1. Cont'd.

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Fisheries and (Contd) Shellfish	Nonpoint source discharges to water	1	Health Ecological Economic	Increasing Stable Increasing
	Acid deposition	4	Ecological	Stable
	Hydrologic disruptions	3	Ecological Economic	Increasing Stable
	Sudden and accidental releases	4	Health Ecological Economic	Uncertain Uncertain Stable
	Wetlands loss/degradation	2	Ecological Economic	Increasing Increasing
	Nonchemical impacts on recreation lands	3	Ecological Economic	Increasing Increasing
Fish and Wildlife	Radioactive releases	4	Health Ecological Economic	Decreasing Decreasing Decreasing
	Nonionizing radiation	5	Health Ecological	Increasing Increasing
	Global warming and ozone depletion	3	Health Ecological Economic	Increasing Increasing Increasing
	Point source discharges to water	1	Health Ecological Economic	Increasing Increasing Increasing
	Nonpoint source discharges to water	1	Health Ecological Economic	Increasing Stable Increasing

Table 1. Cont'd.

Resource	Relevant Threats to Resource(1)	Risk Management Priority Level(2)	Risks Evaluated(3)	Trend(4)
Fish and Wildlife (Contd.)	Acid deposition	4	Ecological	Stable
	Hydrologic disruptions	3	Ecological Economic	Increasing Stable
	Sudden and accidental releases	4	Health Ecological Economic	Uncertain Uncertain Stable
	Litter	5	Health Ecological	Not estimated Not estimated
	Wetlands loss/degradation	2	Ecological Economic	Increasing Increasing
	Nonchemical impacts on forest lands	2	Ecological Economic	Stable Increasing
	Nonchemical impacts on recreation lands	3	Ecological Economic	Increasing Increasing
	Nonchemical impacts on range lands	4	Ecological Economic	Increasing Increasing
	Nonchemical impacts on agricultural lands	2	Ecological Economic	Increasing Decreasing
	Pesticides	3	Health Ecological	Uncertain Uncertain

Notes:
(1) Relevant threats are presented in the order in which they are listed in Figure 1.
(2) The overall risk management priority level for each threat. Threats were grouped in five distinct priority levels by the Public Advisory Committee.

Table 1. Cont'd.

(3) This column indicates which risks (human health, ecological, and economic damages) were evaluated for the listed threat. Health risk evaluations were performed for 16 threats; ecological evaluations were performed for 20 threats. Health and ecological risk evaluation reports are included in Volume III of the State of the Environment Report. Economic damages risk evaluations were performed for 17 threats and are included as an appendix to Volume III.

(4) The trend is presented as either increasing, decreasing, or stable and is based upon the judgement of the lead authors for health and ecological risk evaluations as reviewed and discussed by the Technical Advisory Committee. The economic damages trend is based upon the judgment of the economic consultant who prepared the economic damages reports as discussed with the Technical Advisory Committee.

Table 2. Public Advisory Committee Ranking of Risk Management Priority for 23 Threats to Environmental Resources

Priority Level (1)	Threat to Environmental Resources
1	Ambient Air Pollution
	Point Source Discharges to Water
	Nonpoint Source Discharges to Water
2	Drinking Water Contamination
	Uncontrolled Hazardous Waste Sites
	Wetlands Loss/Degradation
	Nonchemical Impacts on Forest Lands
	Nonchemical Impacts on Agricultural Lands
3	Indoor Air Pollution
	Hydrological Disruptions
	Global Warming and Ozone Depletion
	Regulated Hazardous Waste Sites
	Nonhazardous Waste Sites
	Nonchemical Impacts on Recreational Lands
	Pesticides (i.e. not covered elsewhere)
4	Indoor Radon
	Radioactive Releases
	Acid Deposition
	Sudden and Accidental Releases
	Nonchemical Impacts on Range Lands
5	Nonionizing Radiation
	Materials Storage
	Litter

Note:

(1) All threats at each priority level are considered a higher risk management priority than the threats included on the next level. Although the different priority levels are considered distinguishable, the degree of difference in priority was not determined. Threats are not ranked within each priority level. Within each priority level, threats are listed in the order in which they are listed in Figure 1 on page 5.

Table 3. Rationale for Public Advisory Committee Risk Management Priority Ranking

Priority Level	Threat to Resources	Key Points of Rationale
1	Ambient Air Pollution	• A common problem, affecting entire population. • Exposures and resulting effects are widespread. • Many sources of risk, dispersed throughout state. • All risks were relatively high: health, ecological, and economic. • Risks are controllable, although controls are harder for mobile sources. • Trend is toward increasing risks. • Recent information has highlighted toxic air emissions. • Impacts/risks are hard to avoid. • Air problems are often visible and command attention.
1	Point Source Discharges to Water	• High magnitude of effects on ecological systems. • Similar in comparative terms to nonpoint discharges to water. • Includes urban and developed areas stormwater runoff. • Major programs exist, but for only some of the sources.
1	Nonpoint Source Discharges to Water	• Risks are pervasive and not well contained. • Control programs are not well developed. • High level of concern in all factors (i.e. health risk, ecological risk, economic risk, trend, controllability).
2	Drinking Water Contamination	• Actual, measured contamination has been quite limited, but drinking water resources are vulnerable. • Large numbers of people potentially affected. • Specific populations could be more severely affected. • Uncertainties about water supply quality. • Trends related to vulnerability, especially for groundwater are a concern. • Access is usually available to public water supplies that are monitored/controlled. • Has become a focal point for many sources of risk to water resources. • Water resources available for drinking water alternatives is quite limited in certain locations. • Water is treatable, but is not necessarily treated to desired level. • Protection is possible through control of sources of contamination.

Management Priority Ranking (contd.)

Priority Level	Threat to Resources	Key Points of Rationale
2	Uncontrolled Hazardous Waste Sites	• Many gaps in information in terms of known and unknown sites. • Achieving actual cleanups is still uncertain. • General public is highly concerned regarding this threat and expects continuing action. • Need for education and clarification of public concerns. • Risk trend should be decreasing over longer term because of recent control initiatives. • Includes any current or future uncontrolled contaminated sites from mishandling hazardous wastes.
2	Wetlands Loss/ Degradation	• Past loss has been extensive. • Many important benefits are in jeopardy. • High uncertainty about current status of the remaining resource.
2	Nonchemical Impacts on Forest Lands	• Conversion of forest lands is major issue. • Erosion problems are still noted. • Tendency toward forest monocultures raises other vulnerabilities. • Any loss of sustainability involves serious economic damages.
2	Nonchemical Impacts on Agricultural Lands	• Importance of preserving lands for food productivity. • Important to statewide and local economies and sufficiency. • Erosion is a continuing concern. • Conversion of lands is a particular issue in urbanizing areas. • Invading weeds are issue on these and other lands.
3	Indoor Air Pollution	• High number of people affected. • High uncertainty about high cancer and noncancer risk estimates. • Institutional obstacles to improvements (e.g. legal, building codes). • Difficult to control exposures in private homes. • Education programs could be effective. • Not an ecological issue, only a health issue. • Not an issue for future of environmental resources.
3	Hydrological Disruptions	• Difficult to reverse many past effects. • Increasing trend of impacts. • Habitat impacts are significant. • No significant direct health risks.

Management Priority Ranking (contd.)

Priority Level	Threat to Resources	Key Points of Rationale
3	Hydological Disruptions (contd.)	• Emphasis could be placed on enforcing existing laws and regulations.
3	Global Warming and Ozone Depletion	• Is more international in scope. • Hard to distinguish from "natural" events. • Ozone depletion is more demonstrable. • High potential cost to wait for definitive proof. • Potential future impacts are immense. • Many different activities contribute to threat. • Controllability is limited within confines of Washington. • Issue demands international response.
3	Regulated Hazardous Waste Sites	• Ranking reflects only treatment, storage, and disposal sites and risks of regulated handling practices at generator's sites. • Lack of a commercial waste disposal site is an issue in ensuring safe disposal capacity. • Small generators are regulated/inspected infrequently. • Improper handling or disposal can cause contaminated sites (see Uncontrolled Hazardous Waste Sites). • Hazardous waste risks are also reflected in other threats (i.e. small quantity disposal in nonhazardous waste sites, careless handling resulting in point or nonpoint discharges to water, sudden and accidental releases, leaks during materials storage).
3	Nonhazardous Waste Sites	• Flexible management options are available. • Much implementation of controls still to be achieved. • Overall capacity of sites is a more significant issue. • Intense local issue demanding continuing resolution. • Technical controls are known and available to reduce risks. • Many disposal restrictions are now being applied at sites.
3	Nonchemical Impacts on Recreational Lands	• Many types of lands affected. • Is major "quality of life" issue (i.e. availability of lands for recreation use). • Supply of lands is out of balance with demands.

Management Priority Ranking (contd.)

Priority Level	Threat to Resources	Key Points of Rationale
3	Pesticides (i.e. not covered elsewhere)	• Involves cross-media environmental effects. • If handled properly, acute risks are addressed. • Misuse creates acute risks. • Concerns include maintaining benefits of use. • Information and education could be targeted to urban and household uses. • Impacts on nontarget species are a concern.
4	Indoor Radon	• Technical fixes for homes and buildings are available. • Potential emphasis on private rather than public responsibility. • Is not an ecological issue, and is a high health risk only in localized areas. • Is higher priority for certain local areas affected by health risk. • Skepticism about cancer estimates based on uranium mineworker studies.
4	Radioactive Releases	• Strict controls are in place or being undertaken. • Awareness is high and we are getting more knowledgeable on this threat. • Potential long-term risks are great, but actual impacts or existing risk is limited.
4	Acid Deposition	• Although current impacts are limited, some resources are quite vulnerable to this threat. • Difficult to control mobile sources of acid precursors. • Potential for impacts exists, particularly due to nitrogen oxide emissions from mobile sources.
4	Sudden and Accidental Releases	• More knowledge and ability to respond has emerged. • Usually a shorter term, acute risk. • Some events could be quite major in impact.
4	Nonchemical Impacts on Range Lands	• Threats are difficult to manage. • Problems are identifiable and known. • Conversion is not as much an issue.
5	Nonionizing Radiation	• High uncertainty of actual impacts, and available information suggests relatively low human health and ecological risks. • Some exposures can be avoided. • Exposure does occur, but controls could cause larger problems.

Management Priority Ranking (contd.)

Priority Level	Threat to Resources	Key Points of Rationale
5	Materials Storage	• Control measures are known and include education and enforcement. • Does involve threats to groundwaters. • Relatively lower human health and ecological risks.
5	Litter	• Highly controllable by individuals. • Mostly visible, but not intense effects. • Very diffuse sources (i.e. individuals). • Most visible roadside litter is partially controlled by litter pickup crews. • Also includes beach and marine litter. • Relatively lower human health and ecological risks.

VI. Common Themes and Key Findings

Although it was necessary to break down and categorize the analyses undertaken for the State of the Environment Report in order to organize the work, it is evident that splitting the environment into separate resources and threats to resources is somewhat arbitrary. The environment is more a web of interwoven connections and relationships than it is a set of separate resources. There are no neat and definitive boundaries between environmental resources or among the various threats to these resources. For example, wetlands interact with air, water, and land resources, and provide habitat for fisheries, shellfish, and wildlife. Consider also, that groundwater, potentially contaminated from a variety of sources, may flow to surface waters, then to wetlands, and on to marine waters while depositing its load of contaminants in bottom sediments that support biota browsed upon by fish that are then consumed by humans. The contaminated sediments may eventually be dredged and placed as fill in upland wetlands with the contamination then moving to associated ground water. Ecological cycles represent endless movements of matter and energy.

Whole ecosystems are involved locally, regionally, statewide, and even globally in the interactions of human activities within the environment. The basic physical laws of thermodynamics and conservation of matter and energy dictate that human actions will create reactive ripples of effect in the environment. Human or other species reactions to those ripples will create further environmental reactions and so on it goes.

The risks created in these actions and reactions are pervasive and also not so neatly categorized as health, ecological, or economic risks attributable to neatly packaged and defined threats. Ecological health and human health and welfare are inextricably linked and interdependent. The sources and causes of these risks weave in, out, and through the 23 defined threats. The diffuseness of these risks and sources of risk is also apparent. There is no escape from the reality of environmental risks, nor from responsibility for having contributed to them.

Nonetheless, it is possible to discern some common threads and patterns in the findings of these analyses of resources and threats to resources. Perhaps understanding such common threads and patterns is a means to characterize the "state of the environment" and then to focus on the actions needed to address the beneficial management of the environment.

The analytical results demonstrate that comparative risk assessment is a potentially valuable tool. Such planning oriented risk assessment is a means to provide structure and focus to the array of environmental quality and environmental resource information that is available. Risk assessment extends and clarifies the meaning of environmental resource information in terms of the health, ecological, and general welfare benefits which are the objective of environmental management. Furthermore, the comparison of the magnitude of

risk posed by different threats or issues can lead to a more informed decision process in establishing environmental management priorities. Informed comparative analysis can provide clearer, more rational, and more justifiable priorities.

The ability to conduct analyses to characterize environmental resources and compare environmental risks with confidence is inherently limited by the availability of reliable and relevant information. Availability of information, in a broad sense, refers to both the existence of information and our ability to manage information so that it is readily accessible, can be integrated with other relevant data, and can be presented in a manner which is easily understood. Preparation of a report such as this State of the Environment Report, must be accomplished within a limited timeframe in order to maintain its relevance to a fast-paced, ever-changing human environment. Preparation and communication of the report require effective access to diverse and well-managed information databases. Significant gaps in information or the ability to organize and use existing information were encountered and limited the quality and depth of analysis. Examples include: lack of air toxics monitoring data, no basic database on wetlands, no comprehensive database on nongame wildlife, no comprehensive database on groundwater, and many more. Apart from the absence of information, there is no current ability to integrate pieces of related information from different basic data sets other than by manual comparisons.

Beyond insights into the potential usefulness of comparative risk assessment and need for improved information management, five substantive themes emerge as cross-cutting findings from the resource and risk analyses.

First, the impact of projected population growth (nearly 32% increase by 2010) and the associated human activities that can be anticipated to accompany such growth is pervasive in its potential for increased impact upon environmental resources. Most of this growth will occur in the already populous areas within the Puget Sound region. Transportation related impacts and energy use related impacts may increase at a rate even greater than population growth. This is of particular concern to the quality of the air resource. As a result of this projected growth, environmentally related health risks are generally expected to increase.

Second, toxic chemicals are widespread throughout the environment. Toxic chemicals move from one environmental media to another, sometimes at the behest of management programs seeking to control impacts in one or more environmental media. Control efforts that focus on single environmental media or reactive cleanup have not yet kept pace with either the ability to produce and dispense the toxic materials or the ability to detect the presence of toxic materials in various receptors (i.e. air, water, soils, sediments, animal or human tissues).

Third, impacts from agricultural and forestry uses of land are extensive and involve continuing risks to other environmental resources. Recent and continuing initiatives to mitigate these impacts, such as erosion control, water quality and water use efficiency programs, the Timber/Fish/Wildlife Agreement, and the Old Growth Commission show promise, if fully implemented, in reducing risks from agricultural and timber harvest practices.

Fourth, human activities are creating substantial risks that may only result in significant impacts over a much longer timeframe than 2010. The depletion of soils through erosion is an issue of the long-term productivity of agricultural, forest, and range soils. The most severe impacts from projected global warming and ozone depletion are currently not expected to occur until after 2010. However, the greenhouse gas emissions causing these events have already and are continuing to occur. The potential significance of the risk of radioactive and other releases from the Hanford Reservation is measured in hundreds, if not thousands, of years.

Finally, it is apparent that competition for the diverse benefits derived from the complete array of environmental resources will continue to intensify, leading to conflicts between and among the potential uses and users. Some particulars of these conflicts for each resource follow:

Air - Use of air as a sink for auto, woodstove, tobacco smoke, slash burn and other emissions does and will continue to conflict with interest in clean air for health, recreation, and economic development.

Water - Continued contamination of water will conflict with its use for drinking, recreation, or as habitat. Consumptive uses of water may conflict with each other and with instream water needs.

Lands - Urbanization of lands, particularly in Western Washington, conflicts with maintenance of forest, recreation, and agricultural lands. Multiple demands upon forest lands, particularly old growth forests, are especially intense. Use of recreation lands is becoming increasingly concentrated. Competition and conflicts over land use will continue to intensify.

Wetlands - Loss of wetlands is continuing and urbanization will increase degradation of remaining wetlands. Remaining wetland will experience increased pressure for uses (i.e. recreation, education/research, flood control, wastewater treatment) which may not be compatible with each other.

Fisheries and Shellfish - Incremental habitat losses and degradation from environmental contaminants, the potential for future stresses from global warming, and the demands of an increasing population will intensify existing competition for these resources among users.

Fish and Wildlife - Impacts upon habitat from urbanization, forestry, agriculture, and recreation combined will lead to extinction of some species and pressure on others, particularly nongame species. Some game species are increasing, some are decreasing, but increased population and recreation demands will result in increasing demand for successful game management programs.

The challenge ahead will be to resolve these conflicts in ways which allow for enjoyment and use of the resource while maintaining the sustainability of the resource and not increasing the environmental risks for current and future generations.

This report was prepared as part of a much larger effort to create Washington Environment 2010. The information contained in this State of the Environment Report was used by the Public Advisory Committee to refine their vision of the preferred future for Washington environmental resources and to advise the 2010 Steering Committee of the overall risk management priority ranking of the 23 different threats to environmental resources. After publication in the fall of 1989, this report, together with the Public Advisory Committee's preferred future and priority rankings will be reviewed publicly at a major symposium in November, 1989. After the symposium a draft environmental action plan for 2010 will be prepared for extensive public review prior to finalizing the plan in mid-1990. An updated State of the Environment Report will then be prepared on a periodic basis.

THE STATE OF THE ENVIRONMENT REPORT

VOLUME I
Appendix A

Risk "Controllability" Rating Report

State of Washington
October, 1989

Washington Environment 2010
State of the Environment Report
Volume 1
Appendix A

Risk "Controllability" Rating Report

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Washington Environment 2010
Action Strategies Analysis Committee

Risk "Controllability" Rating System

One component of Washington Environment 2010 entails the evaluation of health risk, ecological risk, and risk of economic damages for 23 different threats to environmental resources. These risk evaluations are being prepared by the Technical Advisory Committee (TAC) and will be the basis for a comparative ranking of those risks by the TAC.

In addition to these risk evaluations, information on the "controllability" of the risks must be developed. The term "controllability" refers to an assessment of various risk management factors that affect our ability to reduce any given risk. Such factors include public awareness and perceptions, legal authority, available technologies and costs. In this context, the terms control or controllability are used very broadly and refer to the complete spectrum of preventive, adaptive, or reactive measures which could reduce risks (e.g. education, regulation, etc.). The Action Strategies Analysis Committee (ASAC) has the responsibility for preparing "controllability" information. This information, along with the technical risk evaluations and rankings prepared by the TAC, will be presented to the Public Advisory Committee (PAC) and Steering Committee for their use in preparing an overall risk management priority ranking of the 23 threats to environmental resources.

The rating system outlined herein has been adapted from similar exercises by EPA in Region I (Boston) and Region 10 (Seattle). It represents a relatively simple means to generate information and professional judgment for consideration by the PAC. The ratings and explanations were prepared by those with lead responsibility (see attached list) and were reviewed and revised as necessary by the ASAC prior to transmittal to the PAC. The ratings with explanations and the control options considered for each of the 23 threats are attached. A chart summarizing the numerical ratings for all 23 threats is also attached.

Explanation of Criteria and Definition of Rating Values.

"Controllability" of risks are rated according to the following seven criteria.

I. Evidence of public awareness regarding the identified risks.

Rating by this criteria is intended to convey information on tangible evidence of heightened public awareness. This criteria rating is <u>not</u> meant to assess the general level of public perception of risk or support for risk reduction, which is a much broader question.

Rating Values

1. Little or no apparent public awareness or interest in risks posed by the threat.

2. Established environmental or other organizations have made inquiries, requested meetings, or requested information related to a threat because of perceived risks.

3. Environmental organizations or other citizen groups have written formal comments or presented testimony at public meetings indicating opposition to or support for a project or situation based upon perceived risks associated with the threat.

4. In addition to the situation of #3 above, legislative inquiries have been made related to the threat and risks, or the threat and associated risks have been the subject of extensive media coverage.

5. In addition to the situation of #3 and #4 above, legal actions have been filed against local, state, or federal agencies because of alleged failure to resolve the threat/risk to the potentially affected public to the complainant's satisfaction.

II. Existing legal authority

This rating will indicate the extent and development of existing legal authority.

Rating Values

1. No state or federal law exists that is applicable to controlling the risks associated with the threat.

2. Applicable state and federal laws exist but are obviously inadequate to control the relevant risks.

3. Applicable state and/or federal laws exist and are not obviously inadequate, but have not yet been implemented.

4. Applicable state and/or federal law is adequate to address the relevant risk and is being implemented. (e.g. implementing regulations adopted).

5. In addition to the situation of #4 above, state and/or federal regulation under the legal authority (i.e. rules and/or enforcement) have been supported in judicial case law.

III. Existing control programs and adequacy to address identified risks

This rating should focus on existing state, federal, and local government programs that are mandated to address the identified risks. What is their stage of development? What percent of estimated needed resources are available to those programs?

Rating Values

1. No control program for the risks associated with the threat have been established.

2. Control programs have been established, but are just beginning to be implemented and/or they are operating with less than 10% of the estimated resources needed to address the threat.

3. Control programs have moved beyond initial implementation, but have not yet been fully developed to address the threats for which they originally established and/or they are operating with less than 25% of estimated needed resources.

4. Control programs have fully matured to address threats for which they were originally established, but major additional responsibilities or needs have been identified for which programs have not yet been developed and/or the programs are operating with less than 50% of estimated needed resources.

5. Control programs have stabilized in terms of program growth and in terms of risks being addressed and have adequate resources to address applicable risks.

IV. Availability of risk reduction technology

Are applicable technologies or risk management techniques readily available?

Rating Values

1. Risk reduction technologies are either completely unavailable or experimental and unproven.

2. Risk reduction technologies are new; have been tested in pilot programs but are not yet in widespread or full-scale use.

3. Very mixed risk reduction technology situation, some technologies not yet available, some new technologies now available, and some proven technologies are available but only address a fraction of the relevant risks.

4. Proven technologies are widely available but require time and experimentation to fit to individual situations (i.e. major production process changes are required or the technologies must be borrowed and adapted for application).

5. Proven "off-the-shelf" technology with little need for testing or modification (i.e. any process or operating changes are relatively minor and easy to implement).

V. Effectiveness of risk reduction technologies

How effective would the available technologies be at reducing identified risks, if they were fully implemented?

Rating Values

1. The risk reduction technologies, even if fully implemented, have little potential to reduce any significant portion of the identified risks (i.e. <5%).

2. If fully implemented, the risk reduction technologies have a realistic potential to address only a small portion of the identified risks (i.e. 10-25%).

3. If fully implemented, the risk reduction technologies have a realistic potential to address a substantial portion of the identified risks (25-50%).

4. If fully implemented, the risk reduction technologies have a realistic potential to address a majority of the identified risks (i.e. 50-75%).

5. The risk reduction technologies, if fully implemented, have the potential to essentially address the identified risks (i.e. >75% risk reduction).

VI. Costs to responsible persons of implementing risk reduction technologies

What is the estimated cost, within an order of magnitude, of applying risk reduction technologies? This should include the costs to the responsible entity of implementing risk reduction technologies, but not the cost of any possible government programs to administer or regulate the application of the technologies. If feasible, include a total dollar estimate when explaining your rating, based upon annual average costs estimated over the next 20 years (i.e. to 2010).

Rating Values

1. The gross estimated cost of implementing risk reduction technologies is more than $500 million.

2. The gross estimated cost of implementing risk reduction technologies is between $50 million and $500 million.

3. The gross estimated cost of implementing risk reduction technologies is between $5 million and $50 million.

4. The gross estimated cost of implementing risk reduction technologies is between $1 million and $5 million.

5. The gross estimated cost of implementing risk reduction technologies is less than $1 million.

VII. Overall controllability of the identified risks

After considering all of the ratings and explanations for the previous six criteria, what is your best professional judgment as to the overall controllability of the identified risks. Your explanation of this rating should indicate which of the six criteria you considered to be a greater factor in assessing overall controllability and why you reached that conclusion. This information and conclusion will be delivered to the PAC and Steering Committee with the caveat that it is meant to inform, but not substitute for, their own considered conclusion.

Rating Values

1. Low overall risk controllability rating.

2. Moderate to low overall risk controllability rating.

3. Moderate overall risk controllability rating.

4. Moderate to high overall risk controllability rating.

5. High overall risk controllability rating.

Washington Environment 2010
Action Strategies Analysis Committee

Risk "Controllability" Exercise Lead Responsibilities

Threat to Environmental Resources	ASAC Agency Assigned	ASAC or Ecology Subcommittee Lead Responsibility	Phone Number
Ambient air pollution	Ecology	Stu Clark	459-6256
Indoor air pollution	Agriculture	Candace Jacobs	586-5310
Radioactive releases	Ecology	Max Power	459-6670
Indoor radon	Energy	Linda May	586-5056
Nonionizing radiation	Health	Eric Slagle	586-5212
Global warming and ozone depletion	Ecology	Doug Canning	459-6785
Point source discharges to water	Ecology	Stan Springer	438-7040
Nonpoint source discharges to water	Ecology/Wildlife	Stan Springer/	438-7040
		Chris Drivdahl	753-5720
Drinking water contamination	Health	Eric Slagle	586-5212
Acid deposition	Ecology	Stan Springer	438-7040
Hydrologic disruptions	Ecology	Ken Slattery	459-6114
Active hazardous waste sites	Ecology	Tom Cook	459-6299
Inactive hazardous waste sites	Ecology	Emily Ray	438-3031
Nonhazardous waste sites	Ecology	Tom Cook	459-6299
Materials storage	Ecology	Tom Cook	459-6299
Accidental releases	Ecology	Jon Neel	459-6039
Litter	Ecology	Bill Alkire	438-7145
Wetlands loss/degradation	Ecology/Wildlife	Doug Canning/	459-6785
		Chris Drivdahl	753-5720
Nonchemical impacts on forestland	DNR/Wildlife	Stan Biles/	753-5308
		(John Shumway)*	
		Chris Drivdahl	753-5720
Nonchemical impacts on recreation lands	IAC/Parks	Greg Lovelady/	753-7140
		Nina Carter	753-6179
Nonchemical impacts on rangelands	Agriculture/DNR	Candace Jacobs/	786-5310
		Stan Biles/	753-5308
		(Pat Hennessy)*	
Nonchemical impacts on agricultural lands	Agriculture	Candace Jacobs	586-5310
Pesticides (i.e. food residues, drift)	Agriculture/ Health	Candace Jacobs/	586-5310
		Eric Slagle	586-5212

*John Shumway (753-0671) and Pat Hennessy (586-6382) are principal authors of forestlands and rangelands controllability papers, respectively.

Washington Environment 2010

Action Strategies Analysis Committee - Ecology Subcommittee

CONTROLLABILITY RATING

THREAT: Ambient Air Pollution

RISKS: Human Health, Ecological, Economic

° Technical Control Options

- Add on controls to existing sources: Use best demonstrated emission reduction technology on point sources, either considering economics of that technology (BACT) or ignoring costs (LAER). Require BACT for toxics on existing sources.

- Implement volatility limits for consumer products such as paints, surface coatings, solvents and motor fuels.

- Institute additional vapor recovery controls for large sources of volatile hydrocarbons, especially motor fuels.

- Expand and strengthen the motor vehicle emission inspection program.

- Require retrofitted air pollution control devices (catalytic converters) on pre-1975 motor vehicles.

- Require retrofitted control devices (catalysts) on older, non-certified wood stoves.

- Set additional contaminant limits for fuels for such constituents as sulfur and heavy metals and follow through on existing federal (TOSCA) requirements for reporting of fuel quality.

° Non-Technical Control Options

- Require greater than one-to-one offsetting reductions for all pollutants when new sources are constructed and existing sources expanded.

- Expand geographic boundaries or increase number of geographic areas considered pristine such as wilderness and national parks. These areas are call Class I areas in federal law.

- Require improved energy efficiency and conservation standards for buildings and appliances.

- Encourage/induce switch to low carbon and alternative fuels.

- Encourage/induce/require switching to available, less polluting and more efficient energy producing methods such as gas-fired turbines and integrated gasification combined cycle.

- Encourage/induce/require increased use of mass transit and other transportation control measures that reduce use of single occupancy vehicles and reduce the number of vehicles on the road at any one time and reduce total vehicle miles travelled.

- Require government purchase of only high mileage and clean burning vehicles.

- Encourage/induce changes in home heating methods to cleaner technology.

- Ban or severely restrict outdoor burning including slash, agricultural, and land clearing.

- Ban wood stoves (non-certified).

- Increase public education/awareness efforts that tie personal habits and choices to their air pollution potential.

- Incorporate air pollution reduction into land use planning and zoning decisions.

CRITERIA I: Public Awareness of Risk — Rating = 5

The public is very aware of air pollution issues and problems. Extensive media coverage, litigation, lobbying efforts by the environmental community, the regulated community, and the general public have been and are occurring. There is extensive interest in selected air pollution issues by the public and policy makers. If there is any reason to consider a lower rating, it would be that, in Washington, much of the public considers air pollution for the most part as a controlled risk. Unless the air pollution problem is generated by a local specific source like a garbage incinerator, or an international phenomenon like global warming, the public considers air pollution an important issue but figures it is under control.

CRITERIA II: Existing Legal Authority — Rating = 3

The basis for much of the air pollution control authority is reactive, not preventative. Some authorities can only be implemented after health based standards are exceeded or emissions are shown to be hazardous to health. Some preventative strategies, especially those that would offset increased pollution from increased population and projected commercial and industrial activities, are difficult or impossible to implement within existing legal structure. Specific examples are fuel volatility limits to prevent future ozone standard

violations and regulation of toxics from existing sources. Prevention of significant deterioration provisions of the federal Clean Air Act do consider prevention but are only applicable to criteria pollutants and certain sources.

There is no specific authority to protect the environment from ecological or economic damage due to air pollution. The ability to define or control operating parameters at existing sources that may affect emissions is very limited. Existing air pollution sources can, in many cases, only be reviewed for added controls if violations of standards occur or major modifications to the facility are planned. Present law does not specifically exclude regulation revisions designed solely to apply improved technology. Periodic review and renewable permits are not available. Penalty limits are low enough that some recalcitrant sources will absorb them as a cost of doing business. Non-toxic (to humans) compounds that create ecological damage are almost impossible to regulate. Example: chlorofluorocarbons (ozone depletion).

CRITERIA III: Existing Control Programs and Adequacy to Address Risks — Rating = 3

Control programs in many instances have been implemented and are matured. However, in some cases, even though legal authority exists to further regulate, significant resource constraints have resulted in no action. Examples would be case-by-case regulatory orders and source category regulations. In other instances, the intent and content of the law clearly limit where and how controls may be applied. *See Criteria II.

CRITERIA IV: Availability of Risk Reduction Technology — Rating = 5

With few exceptions, instituting known and available air pollution reduction technologies, would solve and prevent future air pollution problems. In air pollution terms, could we today write a plan using existing technology (ignoring legal and monetary constraints) that would show "attainment" of all risk based pollution thresholds in all areas of the state? The answer is yes.

CRITERIA V: Effectiveness of Risk Reduction Technologies — Rating = 4

This criteria was not rated 5 in recognition of a number of realities. Operating control devices are for the most part, readily available, in many cases costly, some requiring testing or modification, and there will always be some degree of noncompliance and mechanical failure. The in-use efficiency of some control devices on personally used pollution sources such as wood stoves and motor vehicles, can be low if the devices are misunderstood, neglected, abused or if willful tampering occurs. "People pollution" is hard to regulate. For example, switching to transit or car pooling from single occupancy vehicles is

difficult to require and if required, to enforce. To some extent, each control option trades one pollution problem for another, not just from one resource to another (water to air) but also within the same resource. For example, if significant numbers of people shift from private cars to buses, there would be a net air pollution benefit (decrease in overall pollution), but there would be an increase in diesel emissions.

CRITERIA VI: Costs to Implement Risk Reduction Technologies Rating = 2

Costs for mass transit and other transportation control measures to reduce vehicle miles travelled were not considered solely air pollution risk reduction costs. The bulk of these costs were considered as transportation improvement and safety, with less than ten percent applied to air pollution risk. It was also assumed that $3500/ton of emission to be controlled is a reasonable but high end cost/benefit ratio and that this cost would be applicable to all reductions and strategies. Thirty-five hundred dollars per ton ($3500/ton) is a pollution control cost presently used by EPA when developing new source performance standards and is an annualized cost that includes capital investment and operating expenses.

Emissions of volatile organic compounds (VOC) and nitrogen oxides (NOX) need to be controlled to reduce ozone risk. Carbon monoxide (CO), particulate (PM10), and identified toxics need to also be controlled. Based on the 2010 emission inventory and growth projections in the air resource characterization report, and the fact that all pollutants need not be reduced evenly statewide, a ten percent reduction need was applied to total emissions for those regions where problems exist. These assumptions tend to overestimate the true costs because some pollution sources can be controlled for less than $3500/ton and the air quality control regions used are larger geographical areas than the actual problem areas, especially for toxics, particulates, and carbon monoxide.

CRITERIA VII: Overall Controllability of Risks Rating = 3

The good news is that strategies are known and technology readily available to solve most of the ambient air pollution problems. The bad news is that costs are high and there is a long way to go politically and in public education and acceptance of lifestyle changes necessary to solve some problems. There are also significant resources needed to be able to adequately administer programs to control the risk. In some cases, such as energy and fuel efficiency, existing business and market structures create disincentives to improve.

There are many sources and types of air pollution and a large array of control options. There is starting to be and must continue to be increased emphasis on less traditionally thought of air pollution

sources such as motor vehicles, outdoor burning, and wood stoves. The so-called criteria pollutants (CO, 03, SO2, NO2, Pb, PM10) from point sources are reasonably well controlled although more work is necessary. Non-point sources like those mentioned above are major contributors and will become more significant because they are directly tied to future population growth and its associated activities. Generally, controlling pollution from the non-traditional sources is cheaper per ton than adding technology to existing industrial sources.

Washington Environment 2010
Action Strategies Analysis Committee

Controllability Rating

Threat: **Indoor Air Pollution Other Than Radon**
Risk: **Human Health**

This report addresses the basic and broad control options that could be applied to reducing the risks identified in the human health risk evaluation report written for the indoor air pollution threat. Indoor concentrations of most air pollutants are considerably higher than outdoor concentrations of these pollutants. The primary contributors to indoor air pollution include pollutant transport from outdoor air, interior pollutant sources, and inadequate ventilation.

Control Options

Individual actions:
-- Increase natural ventilation, such as opening windows
-- Mechanical ventilation with room fans or forced air
-- Utilize full-service pumps at service stations to reduce exposure to fuel components
-- Dispose of unused paint cans, aerosol sprays, cleansers, solvents, etc., or store in a detached garage or tool shed.
-- Discontinue use of room air fresheners or switch to brands that do not contain p-dichlorobenzene
-- Discontinue smoking, smoking only outdoors or in well-ventilated rooms, or install air cleaners
-- Air out dry-cleaned clothes on a balcony or porch for a few hours before hanging them in a closet
-- Attach charcoal filters to kitchen and bathroom taps to remove chloroform and other trihalomethanes from water supplies
-- Utilize electric heating and cooking appliances rather than gas or wood-fired appliances
-- Professionally remove or encapsulate asbestos containing materials to prevent emission of fibers
-- Maintain and clean heating, ventilation and air conditioning (HVAC) units to ensure optimum operation and minimal biological contamination
-- Engage in activities that contribute to indoor air pollution such as refinishing furniture or stained glass outside of the home in a well ventilated area

Organizational actions:
-- Reduce toxic emissions from manufactured products, either by modifying manufacturing processes or substituting less toxic chemicals
-- Increase control research
-- Standardize sampling and analysis for indoor air pollutants in areas other than industrial settings

-- Adopt voluntary building standards to limit emissions for building materials
-- Educate the public regarding use of materials or activities likely to contain or emit air pollutants
-- Educate manufacturers on reducing the hazards associated with emission of air pollutants from certain building materials and consumer goods

Controllability

1. Evidence of public awareness and concern regarding the identified health risks Rating = 5

Inquiries and/or investigations have been made by a few federal agencies, including OSHA, NIOSH, and EPA concerning the problem of indoor air pollution. In fact, EPA has identified this problem as a priority issue in its Unfinished Business report. State and local health departments have received many inquiries for information on indoor air pollution from the public. Legislative inquiries have been made in states such as Minnesota and Washington concerning the control of sources of indoor air pollution, including tobacco smoking laws, product use laws, etc. Personal injury suits have been filed in Washington because of health problems occurring in persons exposed to indoor air pollutants.

2. Existing legal authority Rating = 2

Some state and federal laws exist, especially concerning smoking indoors and in public conveyances, but these are inadequate to control the relevant risks of smoking, let alone risks from other contaminants such as formaldehyde. No single agency has been identified to regulate indoor air quality outside of the occupational environment. It is improbable that any regulations would address indoor air quality in private residences. Product-based regulation requirements that would ensure reduced amounts of chemicals emitted from building materials and other products implicated in contributing to indoor air pollution would be difficult to enforce. Laboratory sampling and analytical methods are not standardized outside the occupational setting and, for existing testing procedures, are expensive.

3. Existing control programs and adequacy to address identified risks Rating = 2

Control programs have been established for contaminants such as environmental tobacco smoke, but implementation is not complete. Most components of indoor air pollution are not addressed at all outside of the occupational setting. Many compounds are highly regulated in occupational settings by OSHA in their air contaminants standards, which delineates permissible exposure limits (among other standards) for workers. Such limits are based upon an 8-hour time weighted av-

erage, and are generally set at concentrations above threshold levels which can adversely affect sensitive individuals. Formaldehyde is regulated in mobile home construction by HUD in their manufactured home construction and safety standards. Asbestos in schools is currently addressed by EPA's AHERA program, among others. The intent of this program is to reduce the exposure of school children to asbestos fibers. The EPA Region 10 office has embarked on an indoor air program, which includes elements of networks, public education and training, among others. On the state level, the Governor's Interagency Task Force on Indoor Air is evaluating the indoor air program needs in a report to the Governor due in May. Additionally, the 1989 Legislature passed SHB 1504, which provides for the evaluation of indoor air quality in public buildings, to be coordinated by the Department of Labor and Industries.

4. Availability of risk reduction technology Rating = 3

Risk reduction technologies are new, particularly equipment designed to filter and condition residential air (electrostatic precipitators, for example). Such units are installed and operated in public buildings to reduce particulate matter, but their use in the home is limited at this time. Their effectiveness in reducing gaseous pollutants is not well known. Problems may occur as a result of "tightening" a building, such as sealing cracks, caulking and taping ductwork; all of which may result in decreased fresh air entering the structure and fewer air changes per unit of time. This serves to concentrate contaminants that may be present in the indoor environment. If energy-efficient materials are used in constructing or remodelling a building without concomitant increases in ventilation, the result could be inadequate ventilation rates that maximize concentration of airborne pollutants. Voluntary activities that reduce indoor air pollution are certainly available, but only address a part of the total risk, since most of the compounds that may contribute to indoor air pollution have not been characterized.

5. Effectiveness of risk reduction technologies
Rating = 2

If fully implemented, laws addressing smoking, product emission standards, and ventilation requirements could reduce the risk of indoor air pollution to some extent. Because of the myriad of compounds contributing to the indoor air pollution problem, much of the problem would not be addressed. This is because at present, all of the compounds present in indoor air that may result in adverse human health effects have not been identified, much less characterized. Additionally, the extent of the problems attributed to such exposures is difficult to estimate. Although personal choice management techniques such as not smoking would be effective in

reduction of identified air pollutant levels, mandating or requiring such techniques is not likely to occur.

6. Costs to responsible persons of implementing risk reduction technologies Rating = 2

Costs of implementing the outlined control options are estimated to be between $1 and $5 million annually. The costs of refitting HVAC systems in all public buildings and residences would be quite high. Adding air filtering or cleaning units to existing HVAC systems to reduce particulates would be extremely expensive as well. Implementing and enforcing product standards would be costly for manufacturers. Alternate materials would be required for production in some cases, and the research and development costs for substitute products without decreasing quality would be expensive and time consuming. Modifications of personal activities would be fairly inexpensive, such as airing out dry-cleaned clothes and discontinuing the use of products associated with indoor air pollution.

7. Overall controllability of the identified risks Rating = 2

The risk of indoor air pollution is not easily mitigated by use of control strategies. Such strategies are extremely broad based, and expensive to adopt or implement. The lack of effectiveness of risk reduction technology was the greatest factor in reaching this conclusion. The voluntary nature of most of the control technologies and techniques precludes effective risk reduction and greatly influences the controllability of the risk. Without the realistic ability to control indoor air pollution, whether through equipment or regulation, the chances of accomplishing a reduction in the level of indoor air pollutant concentration are minimal.

Washington Environment 2010
Action Strategies Analysis Committee

CONTROLLABILITY RATING

Threat: Radiation Releases Risk: Health, ecological, economic

Control Options

There are five principal sources of radiation releases considered in Washington Environment 2010: radioactive wastes and contaminated sites, defense nuclear activities, naval operations, nuclear power plant operations, and uranium mining and milling. Risks associated with naval operations and power plant operations are very low given current management procedures. Accidental releases have very low probabilities, but may entail significant consequences. (These were not pursued in the technical papers.) Production of nuclear weapons materials at Hanford has declined since 1987; present operations provide very low public exposures to radiation. There are no active uranium mining and milling operations. Therefore, the major area for control is the management of wastes and contamination to prevent ecological and health impacts over the foreseeable future.

- As long as radioactive wastes are actively managed and monitored, they pose relatively low health and ecological risks. The largest concentrations, totalling some 570 million curies of radioactivity, are stored in tanks or pools, or captured in the soils at the Hanford Reservation. Uranium mine and mill tailings sites constitute a second significant concentration of wastes.

- The major control options are to remove, solidify and dispose of these radioactive wastes, or to stabilize them in place so that they will not migrate into the "accessible environment"--the ground or surface waters, the air, the food chain. Retrieval and/or stabilization technology is available for most stored wastes . Retrieval for some wastes in tanks, and for contamination in soils, as well as stabilization of contaminated plumes in subsurface soils, will require development of new technologies. Retrieval techniques often increase risk to workers. They may also expose the public to risk via airborne particles. Transport of solidified wastes for final disposal may cause very small additional radiological exposures.

- The costs associated with retrieval and stabilization actions are substantial. Timely expenditure to dispose or stabilize permanently, however, will both reduce near-term risks of public exposure and prevent the risk (and the cost of avoiding it) from growing in the long term.

- Control options for other radioactively-contaminated sites, such as uranium mills and reactor spent fuel storage basins, are similar to those described above.

- Risks from nuclear operations are very low. The technical report did not consider risks from accidents associated with these operations. Control measures associated with these operations are very stringent compared to other industrial activities, emphasizing redundancy and passive protections, so that probabilities of accidental releases are also very low. However, the risk associated with these

low-probability/high-consequence events can be further mitigated by emergency preparedness and active monitoring programs.

- Estimated economic risks are also very low. Risk of loss of value due to perceptions of contamination can be reduced in two ways. First, adequate monitoring of contaminated sites can assure the public that no measurable amounts of radioactivity are migrating into the ambient air, water, crops, or other pathways. Second, to the extent the public is satisfied that ultimate disposal methods safely isolate radioactive contamination, they will have less concern about neighboring uses. Public involvement is an important part of controlling risk of economic loss due to perceptions of potential harm.

Criterion #1: Public Awareness of Risk. Rating = 5.

Awareness of perceived risks is very high. There have been extensive public processes in which individuals and groups have testified. The legislature has regularly held oversight hearings concerning radioactive waste issues. The state, interested groups and individuals have filed suit on various aspects of radioactive waste management. State-wide votes have been held in Oregon on continued operation of the Trojan nuclear plant and in Washington on disposal of radioactive wastes. A recent draft EIS concerning final closure of a uranium mill tailing site in northeastern Washington has attracted substantial public and press comment.

Criterion #2: Existing Legal Authority. Rating = 4

The major legal authorities for the cleanup of federal radioactive wastes at Hanford derive from the federal Resource Conservation and Recovery Act, the Comprehensive Environmental Restoration, Compensation and Liability Act, the Hazardous and Solid Waste Amendments Act, the Superfund Amendments and Reauthorization Act, and the state's Dangerous Waste Act and Toxics Control Act. These are related, recognized, and enforced through an agreement between the Department of Ecology, The U.S. Department of Energy, and U.S. Environmental Protection Agency. However, the state has little legal authority to deal with "high level" radioactive wastes that are not mixed with hazardous chemical components. Some 37 per cent of the radioactivity presently stored at Hanford, encapsulated cesium and strontium, falls into this category. The Nuclear Regulatory Commission and the Department of Health have regulatory authority over uranium mill closure, commercial radioactive waste disposal, and operation of commercial nuclear facilities.

Criterion #3: Adequacy of Existing Control Programs. Rating = 3.

Public concern, legal authority, technology, and present planning are generally adequate to support a control program that can handle present-day risks. The resources required to prevent long-term escalation of risk to health and environment have been identified in the Hanford Cleanup Agreement, in environmental impact statements for uranium mill sites, and in a consultant study for the commercial low-level radioactive waste disposal site. The necessary resources are not yet allocated. Implementation of the Hanford Agreement depends on congressional appropriations to match federal commitments. Final closure of the commercial low level waste site depends on the adequacy of funds developed from fees on disposers and on the financial capacity of the private site operator. Funding is uncertain for uranium mill

tailings disposal and closure of mill sites, for which state and tribal governments have yet to finalize plans.

Criterion #4: Availability of Risk Reduction Technology. Rating = 4.

Generally, control of long-term risk requires retrieval, stabilization and permanent disposal of wastes, or stabilization of some wastes or contamination in the ground so that radioactive contamination will not move into the environment. Technologies are generally known for retrieval and solidification, though some refinement remains for various waste streams. In-place stabilization over long periods is also generally available for solid waste disposal sites. Mixed liquid wastes, with both radioactive and hazardous components, some of which have leaked into soils, present a continuing challenge to technological development. Permanent disposal for retrieved and solidified wastes is intended to occur in deep geologic repositories. While scientific opinion holds that such repositories are technically feasible; however institutional and technical problems have so far prevented the opening of a repository for transuranic wastes in New Mexico, as well as the development of a repository for high-level wastes in Nevada.

Criterion #5: Effectiveness of Risk Reduction Technologies. Rating = 5.

If fully implemented, the risk reduction technologies available or developed in compliance with the Hanford Cleanup Agreement will reduce long-term risks to "background" levels.

Criterion #6: Costs to responsible persons. Rating = 1

Estimates of the costs to implement the Hanford Cleanup Agreement range from $30 billion to $57 billion. Under the Hanford Cleanup Agreement, that cost is to be incurred over a thirty year period. That would require an annual average expenditure of as much as $1.9 billion through the year 2010 and beyond. Uranium mill site cleanup is estimated to cost tens of millions of dollars. Closure and perpetual care of the commercial low level radioactive waste site is estimated to cost about $55 million.

Criterion #7: Overall Controllability Rating = 4

Risks from radiation exposures resulting from wastes and contamination at Hanford and other sites, uranium mill tailings, and nuclear plant operations can be controlled. The costs associated with preventing future risks due to environmental spread of contamination are quite high, however, making sustained Congressional appropriations a real challenge. Cost-effective technologies for retrieval, stabilization and disposal of some contaminated soils have yet to be developed. An increase in nuclear power generation or in production of fissile materials for weapons might increase both present-day risks and waste generation, and thus the balance of this assessment.

Washington Environment 2010
Action Strategies and Analysis Committee

Controllability Rating

Threat: Indoor Radon

Risk: Human health, economic damages

Several strategies exist for dealing with the threat to human health from indoor radon exposure. The effectiveness of these strategies varies from situation to situation. However, as a general rule, it is much easier to address radon entry in new home construction than it is to remove radon gases from existing homes. The control options listed below may be used in either existing homes or new construction, though installing some systems in existing homes may be quite expensive.

Control Options:

Active Soil Ventilation -- In most cases, this is the preferred approach to dealing with indoor radon. The object is to prevent radon gases from entering the home. Specific control options in this category include:

- **Sub-Slab Ventilation** -- Radon gases are drawn from the soil through pipes, then exhausted from beneath the slab using fans to establish a low-pressure field.
- **Drain Tile Ventilation** -- Again, fans are used to create a low-pressure field under the home, this time using the tiles installed for drainage in some homes.
- **Block-wall Ventilation** -- The space in hollow block walls is used either to draw gas into the walls and out of the home or to force gas away from the home. This option may only be used in the relatively small proportion of homes with hollow block walls.
- **Isolation/Venting of Area Sources** -- Specific problem areas such as sumps are isolated, then fans are used to ventilate the isolated area.

Passive Soil Ventilation -- Same approaches as above, except reliance is on natural phenomena to operate the systems (e.g. wind) rather than on fans.

House Ventilation -- These methods are used to remove or dilute radon after the gas has reached the slab or entered the home. These approaches can reduce radon concentrations, but have not generally proven effective in completely eliminating a problem. They include:

- **Natural Ventilation** -- Movement of fresh air into the home is increased by opening windows, etc. This strategy is of limited effectiveness because ventilation only occurs when natural driving forces (e.g. wind, temperature) are sufficient to induce ventilation. It is also problematic in extreme temperature conditions.
- **Forced Air Ventilation Systems** -- Fans are used to move fresh air into the home, with or without heat exchange. Such systems may be balanced (including both inlet and exhaust fans) or unbalanced (exhaust or inlet fans only). A balanced system is preferred.

- **Sealing of Soil Gas Entry Routes** -- Openings are sealed between the home and the soil. In particular, any cracks in below-grade walls, slabs, or wall/slab joints are sealed. While this approach may not be sufficient alone to completely control a radon problem, it is often used effectively in conjunction with other methods.

Other mitigation techniques include:

- **House Pressurization** -- Steps are taken either to reduce air movement from the home, thereby avoiding gas influx, or to maintain higher pressure in the portion of the home in contact with the soil.

- **Air Cleaning** -- The decay products from radon adhere to airborne dust particles. These particles can be trapped in a filter or other device as air is circulated through the home. Effectiveness is variable and uncertain since the devices trap only attached radon progeny.

- **Removal from Water** -- Techniques exist to remove radon from water supplies; however, to date this has not been a major concern in Washington.

Criteria #1 Public awareness Rating = 4

Radon has been the subject of much attention in the state, particularly in northeastern Washington and Clark County. The Bonneville Power Administration, the State Energy Office, and in particular the Washington Energy Extension Service's Spokane Office, have offered programs in radon detection, monitoring, mitigation, and education. Radon has also been the subject of legislative inquiries, an interagency and other task forces, and media coverage.

Criteria #2 Existing legal authorithy Rating = 2

In 1986, Congress passed the Indoor Radon Abatement Act. The Act establishes grant assistance programs to states for testing and educational activities. An attempt to procure funds this legislative session was vetoed. The rationale for the veto was that the matching funds available were inadequate and that the eligibility criteria for federal assistance had not yet been determined. The lead agency for pursuing radon grants from EPA (the implementing agency under the Federal Act) in the future is the Department of Health. It should be emphasized that the existing legal authority is geared to radon testing and education rather than to formal regulatory control.

Criteria #3 Existing control programs Rating = 2

The Northwest Energy Code (a codified version of the Model Conservation Standards proposed by the Northwest Power Planning Council) does address the issue of radon control. Jurisdictions which adopt the code have a choice of monitoring for radon or requiring certain building practices in homes which would allow for radon mitigation if a problem appears. No other regulatory program is in place at this time. The program described above for radon testing and education is in the rudimentary stages.

Criteria #4 Risk reduction technology Rating = 5

Proven technologies exist to deal with the radon threat. The level of technical expertise is also developing, enabling builders/owners to select the most effective mitigation method(s) for each individual situation.

Criteria #5 Effectiveness Rating = 5

In most cases, the available risk reduction technologies are very effective in reducing the radon threat.

Criteria #6 Cost Rating = 4

Experts estimate the total cost of implementing risk reduction technologies in potential "hot spots" in Washington at $40-45 million. Simple division results in an average annual cost of $2 million, although there is no reason to suspect that costs would be distributed uniformly on an annual basis. Costs per house would range from a few hundred dollars for modifications in new home construction to several thousand dollars for extensive retrofitting in an older home. The bulk of this expense is in materials and installation costs. Once installed, operation and maintenance costs on these systems are low (e.g. energy costs for running a fan).

Criteria #7 Overall Controllability Rating = 4

Proven technologies exist for dealing effectively with radon in new home construction. Efforts to reduce future radon problems would be enhanced if radon considerations are incorporated into building codes. At present, however, the bulk of the housing stock is older and would not be affected by changes in the building code. Mitigating radon contamination in existing homes has been largely successful; however, the technologies for removing radon from a home are somewhat less effective than technologies which prevent radon intrusion in the first place. This criteria is given a "4" rather than a "5" to account for potential problems with the existing housing stock.

Sources of Information

The following references provide the information used in this controllability paper and would provide additional information to any interested parties:

EPA, Offices of Research and Development and Air and Radiation. Radon-Resistant Residential New Construction. EPA/600/8-88/087. Washington, D.C. July 1988.

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WASHINGTON ENVIRONMENT 2010

ACTION STRATEGY ANALYSIS COMMITTEE

CONTROLLABILITY RATING

Threat: Nonionizing Radiation Risks: Human Health

Control Options:

Three possible technical control options include:

1. Increasing the height of broadcast towers.

2. Increasing the powerline right-of-way width.

3. Requiring underground distribution lines in cities and residential areas.

Increasing the height of broadcast towers will lower the exposure to radio-frequency radiation to individuals at ground levels by increasing the distance from the radiation source to the exposed population. Increasing the width of powerline right-of-ways also reduces exposure by increasing the distance between the source of the radiation and those exposed on a long term basis. This would not reduce the risk to individuals driving near or under powerlines, but their exposure is very small compared to those who may reside very near distribution lines. A further way to reduce exposure to nonionizing radiation from powerlines is to require the underground installation of distribution lines, particularly in residential areas.

Criteria Number One: Public Awareness of Risk. Rating = 4

Environmental organizations and citizens groups have presented testimony questioning health risks associated with both radio-frequency radiation and powerline frequency radiation. This is evidenced by the public process to promulgate regulations applying to broadcast frequencies in the City of Seattle and to Bonneville Power Administration and other utilities proposals to site powerline right-of-ways and to build even higher voltage transmission lines. In addition, the recent session of the legislature passed a bill to study high voltage fields after receiving testimony from concerned groups.

Criteria Number Two: Existing Legal Authority. Rating = 4

Regulations exist and are being implemented at the federal, state and local levels. These agencies include the Federal Communications Commission, the Bonneville Power Administration and the City of Seattle.

Criteria Number Three: Existing Control Programs. Rating = 4

Major control programs are regulatory in nature and have fulfilled their original purpose. However, additional needs have been identified in the area of determining the extent of the very low level effects of nonionizing radiation, and therefore, additional resources are needed.

Criteria Number Four: Availability of Risk Reduction Technology Rating = 5

Although other control technologies may be available, the three cited above are proven, "off the shelf", technologies which will not need testing or modification.

Criteria Number Five: Effectiveness of Risk Reduction Technologies. Rating = 3

Increasing the distance between the source of radiation and the exposed population substantially reduces the risk of exposure. However, not all exposures can be completely minimized due to the need for communication and power transmission. Therefore, there will always be some exposure to humans even with full implementation of the referenced control options.

Criteria Number Six: Costs to Implement Risk Reduction Technologies. Rating = 2

Increasing the height of broadcast transmission towers is perhaps the least expensive of the three options available. However, in addition to the construction costs there may be an additional liability due to air space infringement (potential for aircraft accidents). The cost of additional real estate to provide the needed right-of-way space, and where necessary, relocation costs for affected residents would be very high. In addition, the construction costs of an underground distribution system in residential areas would also be relatively very high.

Criteria Number Seven: Overall Controllability. Rating = 2

Although there appears to be reasonably effective control technology available, and the legal and regulatory control programs appear to be in place, the overall controllability is predicted to be moderate to low due to the extremely high cost of implementing the controls and the uncertainty of the actual risk from nonionizing radiation. While there is certainly some evidence for the risks perceived by some scientists and concerned individuals, the overall conclusion is that the risk of low level nonionizing radiation is very small (although the numerical value is uncertain) and may not warrant the extremely high costs involved in implementing the control technology.

Washington Environment 2010
Action Strategies Analysis Committee

Controllability Analysis

Threat: Global Warming and Ozone Depletion

Risk: Human Health, Ecologic, and Economic Damages

Introductory Remarks

Of necessity, these analyses differ from other Environment 2010 analyses. First, the pollutants involved are generally benign; it is the impact pathways which they set in motion that are the problems. Second, the pathways are complex and interrelated. The effects of greenhouse gas emissions, for example, lie with an impact chain which begins with global warming, which causes other climatic changes, which causes other secondary and tertiary ecologic effects, and thus human health and economic impacts. Third, the time scale involved is profoundly different. The effects of water pollution, for example, are often immediate and obvious. The effects of the emission of greenhouse gases in past decades are only now being tentatively detected, and the impacts are not yet conclusive. Finally, the control options depend, to a large degree, on national efforts and international cooperation.

Control Options

Control

Control in the context of a normal time frame is not an option at all; due to the 60 year time lag between the emission of greenhouse gases and the resultant atmospheric warming, we are committed to global climate change. In a longer time frame control or at least mitigation of the severity of effects is possible if political will and international cooperation can be mustered.

Control in the strict sense of the word is not an option for Washington state; control must be achieved at the national and international levels, although those measures will likely be carried out at the local government level. Often, however, key states lead the federal government by setting an example in adopting and implementing advanced programs. Thus Washington, in concert with other states such as California, Massachusetts, and New York, could lead the way in control or mitigation measures such as energy conservation, carbon dioxide emission controls, public transit, and reforestation. This could be especially appropriate where such measures can be advocated for their own value in addressing other issues, e.g. air pollution, traffic congestion, or economic competitiveness in international markets.

Adaptation

Energy demand may be lessened through behavioral adaptations aided by state/federal energy efficiency regulatory programs; per capita energy use in northern European nations is about half that of the US with no substantial difference in quality of life. Both regulation and public education would be necessary.

Agriculture in Washington state should be able to adapt to the predicted climate change by means of shifts in crops and cropping practices; forestry should be able to adapt if forest ecology impacts are not too great.

Sea level rise adaptation techniques and technologies exist to a degree in the experience of the Dutch (sea walls and levees) and the British (the Thames River barrage); some low value areas will be subject to abandonment; anticipatory planning could minimize the costs of adaptation.

Fisheries and shellfisheries have not yet been studied, thus adaptation techniques are not certain.

Informative

Adaptive response will require more and better information than we now have; joint state-federal research and monitoring programs should be funded.

Public education will be necessary; the public will not support any regulatory or management program which they neither understand nor consider desirable .

Cooperation at unprecedented levels between and across levels of government will be necessary; the means to achieve this should be fostered.

Criteria 1: Public Awareness of Risk. Rating = 4

A public awareness rating of 4 is clearly appropriate; a rating of 5 might be valid.

There have been numerous Congressional hearings on the matters of global warming and ozone depletion during the past five years. During the 1989 state legislative session, a number of bills were introduced which sought to address various aspects of global warming -- particularly energy related issues -- and ozone depletion, particularly the disposal of products containing CFCs. The 1989 Legislature passed SJM 8011, a memorial to Congress stating their concern for global warming and sea level rise.

National media coverage of the issues is widely known, particularly the December 1988 issue of *National Geographic*, and the January 2, 1989 issue of *Time*. Locally, feature articles have appeared in the *Seattle Post Intelligencer*, the *Seattle Weekly*; news articles have appeared in the *Seattle Times* and many other Washington state newspapers.

The local environmental community has begun to address the issue. Pilchuck Audubon Society sponsored a *Trees For Life* event in Everett which addressed the deforestation aspect of carbon dioxide production and global warming. A Washington state chapter of Greenhouse Action, a national organization, has been formed in Seattle.

Neighborhood groups opposed to Metro's West Point expanded sewage treatment plant (STP) discussed with the author of this rating report the issue of sea level rise and the conceptual design of the STP. The licensing of an upgrading of West Point was not challenged on the sea level rise issue, but such an eventuality for some other shoreline issue is virtually certain.

Criteria 2: Existing Legal Authority. Rating = 2
Overall, the existing legal authority to address the problems is scant. The principal pollutant causing global warming, carbon dioxide is not regulated at all. Recent international accords regarding the principal pollutant causing ozone depletion, chlorofluorocarbons (CFCs), are generally regarded as being inadequate. The level of attention devoted to global warming and ozone depletion by the United States government is considered by many to be substantially behind that of most northern European nations. State and federal coastal zone/shorelines laws appear to provide the authority to address most aspects of sea level rise response.

On the other hand, no new legal authority is necessary to take the first steps necessary to address the issues. First needs are not regulatory or authoritative, but rather informative. However, few studies are underway by state government to address response alternatives. The Washington State Energy Office (WSEO) has been studying global warming in the context of energy supply and demand.

The Shorelands and Coastal Zone Management Program, Washington Department of Ecology, initiated a Sea Level Rise Response Project in September, 1988, to investigate the technical and policy implications of sea level rise for the state. An interagency task force provided guidance. Legislative briefings resulted in passage of SJM 8011 (see above). A study of policy alternatives is expected to be completed by June, 1990.

Criteria 3: Existing Control Programs. Rating = 2
A Sea Level Rise Response Program was initiated in 1988 by the Shorelands & CZM Program, Department of Ecology; funding for FY 1989-90 is less than $100,000. The energy conservation programs initiated for other reasons by the Washington State Energy Office and the Northwest Power Planning Council will have applicability to global warming. No other programs dedicated to global warming have been initiated in the state. A King County Office of Science and Technology Planning has been proposed, but not yet adopted by the King County Council.

Criteria 4: Risk Reduction Technique Availability. Rating = 3
The available risk reduction technology and techniques ranges from "unavailable" to "proven." The rating of 3 is simply an average.

Proven technology for sea level rise response, for example, is exemplified by the Dutch levees which protect below-sea-level portions of the Netherlands, or the Thames River barrage which limits intrusion of the North Sea into the interior of Britain.

Unavailable technology/techniques, for example, is exemplified by our inability to affect the northward movement of the southern limits of some salmon species out of Washington waters, or the change in climate itself.

Criteria 5: Risk Reduction Technique Effectiveness. Rating = 3
If fully implemented, the risk reduction technologies and techniques do have a potential to address a substantial portion of the identified risks. It is important to remember, however, that we are committed to a certain measure of global warming and ozone depletion simply because of the time lags. There appears to be a 60 year time lag between the introduction of greenhouse gases into the atmosphere, and an identifiable climate change. Many ozone destroying substances have active lives in the atmosphere from 100 to 400 years.

Criteria 6: Costs to Implement Risk Reduction. Rating = 1
The costs of risk reduction and adaptation will include contributions to both state and federal responses. No reliable, comprehensive, short term cost projections have been developed for adaptation to global warming and ozone depletion nationally or in Washington state. Also, the costs will be inescapable; for the most part, we will have no choice. For example, we can either respond to sea level rise by protecting urban areas, or we can bear the cost of abandonment and reconstruction.

One way to get a perspective on the costs of "controlling" global warming is to look at the implications of the "carbon tax" which is being discussed as a means of inhibiting the use of fossil fuels and other carbon dioxide-emitting activities. A carbon tax has been proposed to be assessed at the rate of $0.01/kilogram of carbon. With annual carbon emissions at about 5 gigatons, the annual impact on Washington would be $150 million (see end notes). Carbon dioxide accounts for about 50% of the greenhouse effect, so assuming that other greenhouse gases could be "controlled" at the same cost (a "poor" assumption, as methane control is much more difficult than carbon dioxide control), the total annual cost would be $300 million.

A $0.01/kilogram carbon tax would add 50% to the cost of coal, one of the highest carbon output fossil fuels. Studies have indicated that fossil fuel costs could quadruple with no substantial effect on use rates or global warming rates. Thus it would appear that a

$0.01/kilogram carbon tax would have little effect. The computed annual impact of $300 million is therefore not an accurate prediction, but is simply a lower bound scenario -- if we choose to address global warming in an effective manner the annual costs will likely be many times higher.

Criteria 7: Overall Controllability. Rating = 3
A moderate overall risk controllability rating was selected as a balance between the high controllability regarding response to some aspects of sea level rise, for example, and the low overall risk controllability regarding general climate change.

End notes.

The carbon tax impact on Washington was derived as follows:

5,000,000,000	5 gigatons annual carbon emissions
X 27%	North American emissions as percent of world total
X 93%	US emissions as percent of North American total
X 1%	Washington emissions as percent of US total
X 1,000	convert to kilograms
X $0.01	compute carbon tax

WASHINGTON ENVIRONMENT 2010
ACTION STRATEGIES ANALYSIS COMMITTEE

Controllability Rating

Threat: Point Source Discharges to Water
Risk: Health, Ecological, Economic Damages

Control Options:

Remedial Control Options:

The process of remedial control for point source discharges requires an identification of a problem and subsequent corrective actions.

- Monitoring of all surface and groundwaters to allow quick response to identified problems. The Department does a limited amount of surface water monitoring including rivers, lakes and marine waters. There is no formal groundwater monitoring.

- Remediation for damage caused by point source discharges requires halting or reversing eutrophication and removal of toxics from sediments.

- In those areas severely impacted by point source discharges limiting the exposure to risk by restricting swimming and/or fishing.

- Restoring affected populations in waterbodies with identified problems after the problem has been corrected.

Preventive Control Options:

- Eliminate the production of the pollutant through waste reduction.

- Eliminate the discharge of pollutant through waste recycling.

- Reduce the discharge of pollutant through waste treatment and management practices. This can be done at various levels of control including the current level of control and an increased level of control through ratcheting down to eliminate discharge of any harmful quantity of pollutant.

- To use a conservative approach in limiting point source discharges because of the uncertainity associated with environmental monitoring.

Criterion 1: Public Awareness of Risk
Rating: 4

Numerous environmental organizations, other state and federal agencies, citizens' groups, and individuals are concerned about the environmental and health risk associated with point source discharges. This is evident from public opinion surveys, extensive press coverage and law suites filed because of alleged failure to aggressively control the risk.

Ecology also receives numerous inquiries from legislators regarding our control of risk from point sources.

Criterion 2: Existing Legal Authority
Rating: 3

State and federal water quality laws regulating point source discharges are well established. Numerous administrative and court hearings have been decided and have generally supported the existing statutes and regulations. The laws and accompanying state and federal regulations are not fully implemented, however, because the program is not fully funded. There are several legal problems in controlling point source discharges. They include the lengthy no risk appeal process for dischargers, the lack of felony provisions in state law and the relatively low cap on civil penalties for violations.

Criterion 3: Existing Control Program and Adequacy to Address Risk
Rating: 4

The control programs for point source discharges have a relatively long regulatory history and are generally accepted by the regulated community. Programs are funded at about 50% of the need, although the need has not been well established. Major new additions to the existing programs are needed to adequately control risk to public health and the environment and to address eutrophication of Puget Sound because of expanding population. Additions would focus on regulatory controls for CSOs and stormwater and discharges to groundwater. Regulatory controls for toxics for all point sources and the greatly expended effort to reduce or eliminate discharge of any pollutant through waste reduction and waste recycling would also be needed. Also, ratcheting down of regulatory effluent limits is necessary to ensure ultimate elimination of the discharge of any harmful pollutant.

Criterion 4: Availability of Risk Reduction Technology
Rating: 4

Although some proven off the shelf technology is available to control the risk from point source discharges, much of the technology must be custom fit to the individual situation. In addition, long lead times are

required for construction of waste treatment facilities or changes in production processes to reduce or recycle waste. Very little technology development has been done since the major effort in the 1970's. There is a great need for development of more efficient and cost effective treatment technology.

Criterion 5: Effectiveness of Risk Reduction Technologies
Rating: 4

This rating assumes that the existing regulatory control system remains in place and is continually strengthened to correct problems as they are identified. Additional risk reduction is available if the state moves aggressively to encourage waste reduction. It is through the combination of a strong regulatory program and an aggressive waste reduction incentive program that we can essentially eliminate the risk.

Criterion 6: Costs of Implementing Risk Reduction Technologies
Rating: 3

The 1987 Washington State Water Quality Protection Needs Evaluation shows $760 million needed to control municipal point source pollution in this state. Added to this is an additional $180 million to control combined sewer overflows and $210 million to control stormwater. The cost to industry for point source controls has not been identified. The numbers presented above are not a risk control level, but are based on technology controls, i.e., our municipal wastewater facilities must be at secondary treatment. In some cases, additional treatment may be required to control risks. In some cases, less treatment would be adequate to control risks. The cost of an aggressive waste reduction and recycling program to reduce or eliminate discharge of pollutants is unknown. However, several large companies have reduced waste discharge by over 50% with alternatives that pay for themselves within three to five years. If this were true industry-wide, a 50% reduction waste and associated risk reduction is possible at no cost. Additional waste reduction can be accomplished at some cost to the responsible corporation, but the magnitude of these costs is unknown.

Overall Controllability
Rating: 4

The threat of point source discharges to water is controllable to a very large degree. Existing regulatory controls do a good job of controlling the risk. Additional risk control can be obtained by continuing to update our regulatory system and an aggressive waste reduction effort.

WASHINGTON ENVIRONMENT 2010
ACTION STRATEGIES ANALYSIS COMMITTEE

CONTROLLABILITY RATING

Threat: Nonpoint Source Discharges To Water
Risk: Health, Ecological, Economic Damages

Control Options

Animal waste management including manure control, storage and proper field application.

Irrigation water management to control erosion.

Conservation tillage, construction of terraces, and divided slopes to control erosion in dryland areas.

Improved residue, pasture, and rangeland management to control erosion and improve animal waste and nutrient uptake.

Stream corridor management including deferred grazing, fencing, and controlled animal access as well as reestablishment of vegetation.

Pesticide and nutrient management through better timing and restriction of leachable chemicals in ground water recharge areas. Reduction of overall chemical use and conversion to integrated pest management (biological controls) and low input sustainable agriculture.

Forest road design, construction, and maintenance to control runoff and erosion and prevent mass failures.

Forest riparian management zones to buffer streams, provide fish and wildlife habitat, control temperature and provide overall stability.

Proper chemical handling, storage, and application to prevent entry into the water.

Urban stormwater and highway runoff and erosion control through vegetative buffers, mulching, drainage control, retention/sediment basins, grassy swales, revegetation, and pesticide management.

Proper design, installation, and maintenance of on-site wastewater systems.

Erosion control, filtration and sediment basins at gravel pits and mining sites.

Air emission control from industrial facilities and conversion to unleaded gasoline to control atmospheric depostion.

Criterion 1: Public Awareness of Risk. Rating = 3

Beginning in the mid-70's with the nonpoint source requirements of the Federal Clean Water Act, agencies, industry, and interested public groups evaluated the water quality impacts and control strategies. These efforts led to the development of "208" plans for forest practices, dairy waste, irrigated and dryland agriculture. (Rating = 3)
Occasional media and public attention occur following significant events such as fish kills or the release of studies. Public awareness has increased recently with the concern over pesticides. (Rating = 3)

The Timber Fish and Wildlife (TFW) Agreement in 1986 also received media and public attention. Recent discussions of old growth and spotted owl protection combined with the preparation and adoption of Forest Plans by the Forest Service have forestry in the public view. (Rating = 4)

Public awareness of risk from urban runoff and failing on-site wastewater systems is moderate. Very little public awareness exists on risks from resource extraction or atmospheric deposition. (Rating = 2)

Criterion 2: Existing Legal Authority. Rating = 4

Broad legal authority exists to regulate the agricultural industry, however, a balanced program of education, technical assistance, incentives and regulatory back-up has been adopted. Regulatory efforts are slowly increasing but have not been extensively implemented due to the widespread distribution of agriculture and the political climate. Regulations for the application of pesticides are in place with a recent emphasis to improve them and increase enforcement. (Rating = 3)

The Forest Practices Act, the Federal Clean Water Act and the State Water Pollution Control Act provide a firm legal foundation for the regulation and control of forest practices. The legal authority of these statutes and their implementing rules have been supported in case law.
(Rating = 5)

Broad legal authority exists to regulate on-site wastewater (State Board of Health regulations) and resource extraction (Surface Mining Act). EPA has recently adopted regulations for stormwater runoff in large urban areas (>100,000 population) but regulations are not well developed for smaller urban, suburban, and rural areas. (Rating = 3)

Criterion 3: Existing Control Programs and Adequacy to Address Risks. Rating = 3

Programs to control pollution through the adoption of agricultural best management practices (BMP's) are well developed but progress remains dependent on available resources. Programs to develop and implement BMP's for smaller noncommercial farms and for rangeland and stream corridor management are not as well developed or accepted. Programs to develop and implement BMP's for the protection of ground water need to be developed. (Rating = 3)

The TFW agreement in combination with the legal authorities provides a firm foundation for the ongoing implementation and refinement of the forest practices program. The Memorandum of Understanding between the Forest Service and Ecology provides the assurance that practices will meet or exceed state requirements. (Rating = 5)

Programs addressing on-site wastewater and resource extraction are well established. Stormwater and highway runoff programs are being developed in the Puget Sound area. Stormwater programs and utilities are well established in Snohomish and King Counties and the City of Bellevue. (Rating = 3)

Criterion 4: Availability of Risk Reduction Technology. Rating = 4

Agricultural BMP's are widely available and have proven effective in reducing water quality impacts in the relatively few situations where widespread implementation has occurred in a watershed. BMP's are continually being updated particularly for irrigation and conservation tillage practices. BMP's for rangeland, stream corridor management, and noncommercial farms are not as well developed or proven. Very little is known about BMP's for ground water protection. (Rating = 4)

The silvicultural BMP's and their effectiveness are generally well known. The processes and control technologies for unstable and hazardous areas are not well understood. The cumulative effects of forest practices and other nonpoint sources are also difficult to identify and are not well understood. A program of adaptive management will result in a refinement of technologies after monitoring, evaluation and research. (Rating = 4)

Technology for addressing on-site wastewater and resource extraction are well developed and available. BMP's for erosion control and stormwater and highway runoff are continually being developed. BMP's for protection for ground water from these sources are not well known. (Rating = 3)

Criterion 5: Effectiveness of Risk Reduction Technologies. Rating = 4

Agricultural BMP's are straightforward common sense approaches to preventing impacts. Management is often the key but if properly implemented by all agricultural producers have the potential to essentially address the identified risks. The exception is the unknown effectiveness of existing BMP's in protecting ground water. (Rating = 5)

BMP's are effective when properly adapted and applied to site specific situations. Large scale processes such as unstable areas are difficult to address as well as to separate natural processes from human activities. (Rating = 5)

BMP's for addressing on-site wastewater and resource extraction are reasonably effective. Evaluation of BMP's for stormwater and highway runoff has just begun and little is known about their effectiveness.

Very little is known about impacts to groundwater. (Rating = 3)

Criterion 6: Costs of Implementing Risk Reduction Technologies.
Rating = 2

Implementation of agricultural BMP's is considered cost effective over the long term. Improved waste management can reduce commercial fertilizer costs and soil conservation assures productivity for future generations. BMP's are not widely accepted and used because of the up front costs and skepticism of long term benefits. Estimated costs for animal waste management are $40 million (800 operations @ $50,000 each), irrigation water management are $30 million (500 @ $20,000 - 100,000 each), dryland erosion control are $10 million (1,000 @ $10,000 each), rangeland management are $10 million (1,000 @ $10,000 each), non-commercial farms are $30 million (15,000 @ $2,000 each) and stream corridor management are $60 million (4,000 miles @ $15,000/mile). Total agricultural costs are in the range of $180 million through 2010.

Costs of implementation of forest practices include higher road construction and maintenance, loss of value of timber left in riparian and other leave areas, and increased operational costs. Costs are likely in the range of $50 million annually or $1 billion through 2010.

Estimated total costs through 2010 of correcting failing on-site systems (5% of 575,000 systems at $2,000 each) are $57.5 million and ongoing maintenance (pumpout every 5 years at $100 each) are $12 million. Costs of stormwater utilities are about $5 per household per month and the cost for new development is about $1,000 per new home. Stormwater is approximately $150 - $200 million per year for a total of $3.5 billion through 2010. Estimated costs for resource extraction are in the range of $5 million/year or $100 million through 2010.

Total costs for nonpoint are in the range of $4.8 billion through 2010 or an average annual cost of $240 million.

Overall Controllability. Rating = 3

Although the programs and technologies (BMP's) are well developed, implementation will continue to be slow due to the widespread nature of agricultural activities and the initial start up costs. The sheer numbers of individuals that need to become aware of the results of their activities and receive incentives and technical assistance makes controllability difficult. Up front and ongoing management costs also slow program implementation. The effectiveness of the small increase in regulatory programs is unknown. Finally, the observed impacts outlined in the risk assessment are significant and widespread. (Rating = 3)

The forest practices programs and technologies are proven and well accepted. The interested and affected parties are committed to working together to identify and control impacts from forest practices. (Rating = 5)

On-site wastewater and resource extraction are well developed programs that have a high potential to control risks. Urban stormwater and highway runoff have significant impacts and costs for control with programs to address them just getting started. (Rating = 3)

WASHINGTON ENVIRONMENT 2010

ACTION STRATEGIES ANALYSIS COMMITTEE

CONTROLLABILITY RATING

Threat: Drinking Water Contamination Risk: Human Health

Control Options:

- Institute land use controls to mitigate discharges which may impact water sources.
- Develop implementable wellhead and surface intake protection programs to preclude contamination.
- Install treatment at all sources that are contaminated.
- Insure that all water systems are tested regularly for contamination.
- Seek alternative sources to replace contaminated water supplies.
- Install protective measures for source and distribution components of water systems.
- Use widespread educational programs to inform the public and water purveyors of potential problems and protective measures.
- Pursue programs which encourage regionalization of water systems to minimize problems with smaller systems.
- Establish state funding programs to subsidize drinking water system improvements or construction.
- Strengthen the regulatory capability for monitoring of, enforcement of, and providing assistance to drinking water purveyors.
- Strengthen the relationship and enhance the funding levels for state and local government drinking water protection activities.

I. Public Awareness (Rating = 5)

The Environmental Protection Agency has made public awareness a major component of their strategy to implement the 1986 Amendments to the federal Safe Drinking Water Act. An emphasis on threats to drinking water quality is often seen in articles published by the national and local news media. A variety of national environmental groups have accentuated the public's awareness through lawsuits asking for more

- The 1986 Amendments will require more coordination between DSHS and Local Health Departments. This is particularly true for activities such as sanitary surveys and collecting water samples. (See Issue Paper No.9)

Impacts

- Each of the required new activities includes significant impacts on the state's drinking water program, particularly program development, lab support, data management and enforcement activities. Over $3 million of start-up costs will be required for these new activities. (See Chart 1, attached)

- The yearly costs of implementing the Amendments will more than double the cost of the current drinking water program, increasing from $1.8 million to $4.5 million.

Conclusions

- It is important for Washington State to maintain primacy. Additional resources should be sought rather than cutting back on the scope of the state's drinking water program. (See Issue Paper No. 10)

- Both DSHS and LHDs will be severely impacted by the SDWA Amendments. Definition of respective roles and reaffirmation of the partnership should take place. (See Issue Paper No. 9)

- Additional state and local staff will be required to carry out the new federal requirements. More federal resources are needed, as well as an additional stable and long term source of state funding. (See Issue Paper No.1)

References

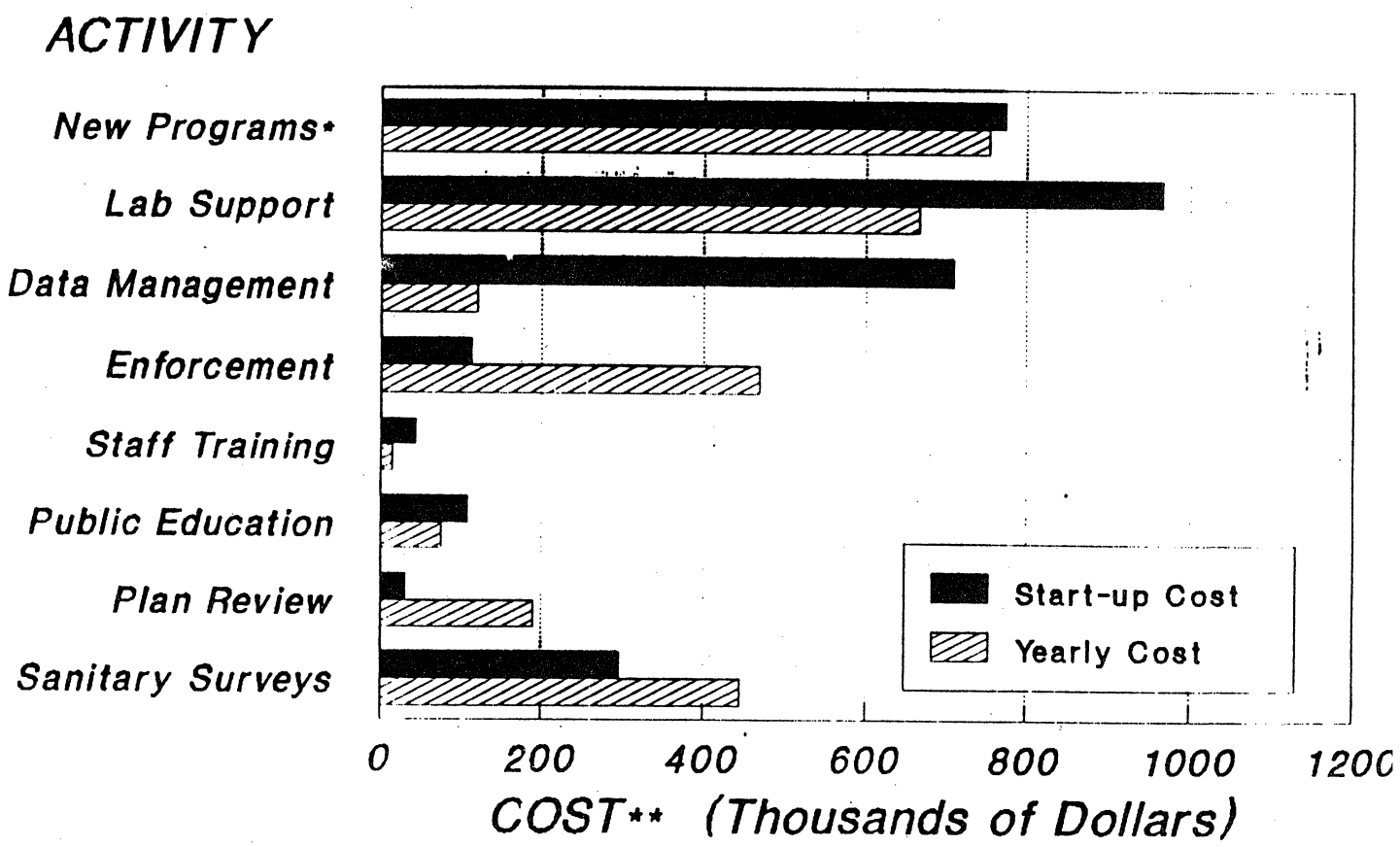
- Federal Safe Drinking Water Act Amendments of 1986 (Public Law 99-339, June, 1986)

- "Survey of State Primacy Program Resource Needs" by the Association of State Drinking Water Administrators, August, 1988.

- The following ISSUE PAPERS: (#1) Gaston Report, (#6) Federal SDWA, (#9) State/Local Relationship, (#10) Impacts of Losing Primacy.

CHART 1

COST OF NEW SDWA REQUIREMENTS



* Includes VOC's, Surface Water, Coliform, Inorganic Chemicals Lead and Corrosion, Radionuclides, et

** Based on additional FTE requirements where 1 FTE is equivalent to $50,000

ISSUE PAPER NO. 12

SDWA IMPLEMENTATION COST FOR PUBLIC WATER SYSTEMS

Summary

The 1986 Safe Drinking Water Act Amendments (SDWA) will have a substantial financial impact on public water systems in this state. Public water systems will incur additional costs to meet the new requirements. The economic impact will be much greater on rate payers in smaller systems than larger systems; this is true for both monitoring and treatment. Smaller systems will have greater difficulty securing financing to meet new requirements. Neither federal nor state resources are available to assist public water systems in financing SDWA mandated costs. All water system budgets will be challenged by these new requirements.

Background

The 1986 SDWA mandates new requirements for public water systems. In the next decade, additional costs will be imposed for monitoring and treatment. Larger systems are now gaining an appreciation of the costs associated with compliance. Smaller systems do not yet realize the impact of the new regulations and will have difficulty complying based on high per capita costs. Securing adequate financing will be a challenge for all systems, especially small ones.

The purpose of this issue paper is to provide a foundation for translating regulatory requirements into costs and to educate the public.

The Department of Social and Health Services (DSHS) data base was used to develop statistics for various categories of systems. Costs associated with SDWA monitoring and treatment requirements were estimated for the various categories of systems.

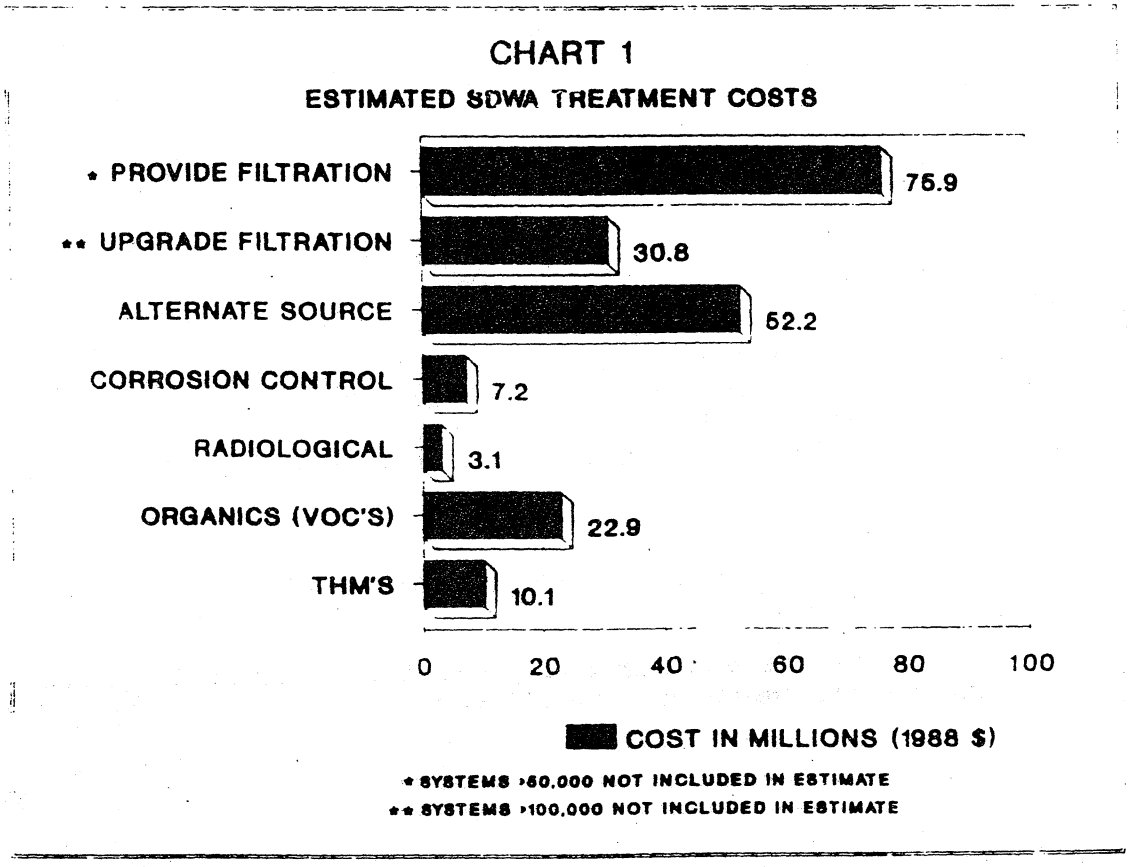
Keypoints

- Smaller systems will be impacted most by the SDWA based on cost/connection.
- Resources are not currently available for most systems to meet the requirements of the SDWA.

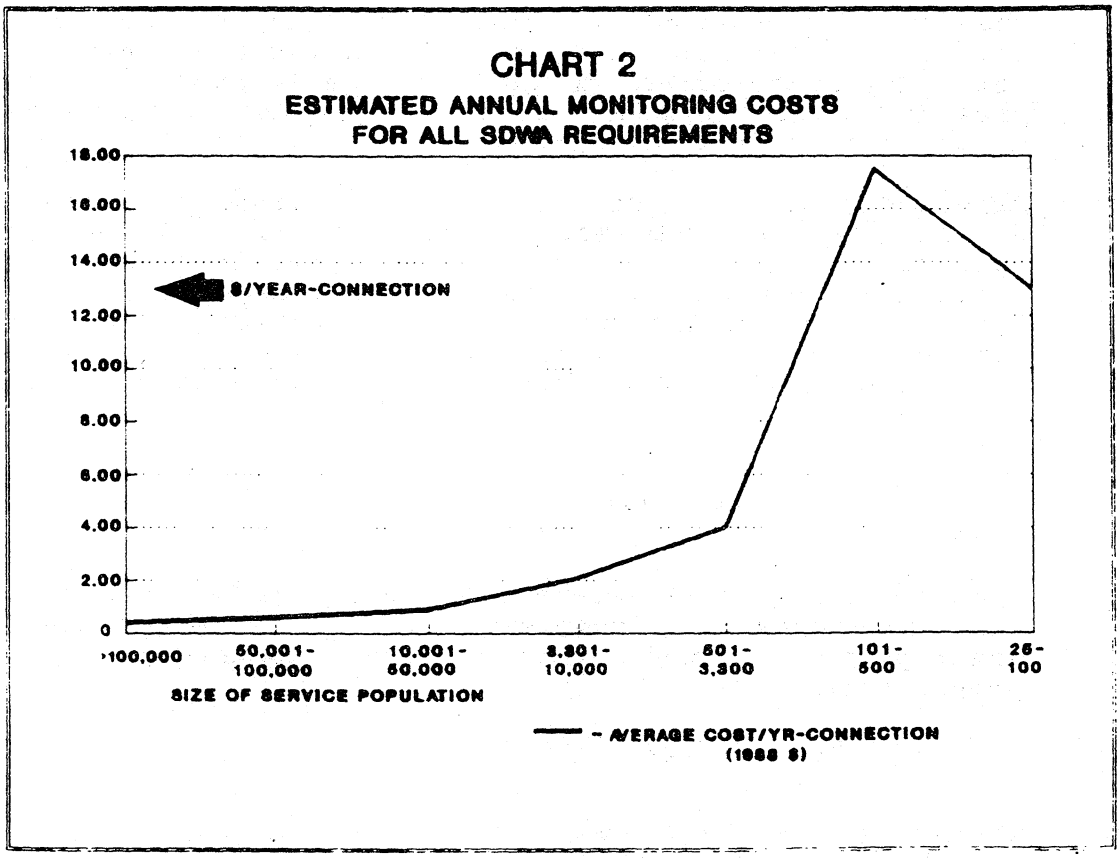
- Water systems should begin budgeting for the new requirements. The state needs to aid utilities by developing and presenting public awareness programs and supporting the development of adequate water rates.

Impacts

- Estimated treatment costs (in 1988 dollars) for compliance with the SDWA are shown in chart 1. Where possible the cheapest option was used to make the estimate. Several references were used and the information is presented assuming all requirements were imposed in 1988. The total cost of treatment to meet the SDWA requirements is estimated to be over 200 million dollars (includes 1988 capital costs and present value of annual O&M at 8% and service life of 20 years).



- Estimates of additional monitoring costs (in 1988 dollars) resulting from the SDWA are shown in chart 2 for several population categories. Estimates assume all requirements began in 1988.



Conclusions

- On a cost per connection basis, smaller systems will incur higher costs than larger systems.

- Smaller systems have traditionally been lacking in operational expertise and financial capability. As SDWA regulations are phased in, smaller systems are expected to have more acute problems.

01/20/89

- The SDWA is expected to create budgeting problems for some utilities. Planning to meet the requirements needs to begin now. The state should develop reasonable cost estimates and present to water systems, especially smaller systems, as part of a public awareness program.

- Referendum monies are no longer available to help with drinking water problems. System rates will need to be adjusted to deal with new monitoring requirements. Capital costs for treatment will need to be addressed through rate increases and public funding mechanisms such as bond sales, referenda, or loan programs. Small systems need to be able to access public support monies much like larger systems.

References

- The following issue papers: (#1) Gaston Report, (#6) Federal SDWA.

- DSHS relied upon 11 separate technical references to derive cost estimates. A complete listing of references and a description of the approach and assumptions is under preparation.

WASHINGTON ENVIRONMENT 2010
ACTION STRATEGIES ANALYSIS COMMITTEE

Controllability Rating

Threat: Acid Deposition Risk: Ecological

Control Options:

Preventive Options include:

- Confirmation and/or Expansion of existing monitoring programs designed as an early warning system for detection of adverse impacts and changes in the potential for adverse impacts. This includes programs for long-term monitoring of both precipitation quality and response of sensitive receptors (e.g. alpine lakes) to atmospheric deposition.

- Reduction in precursor emissions and/or freezing of emission levels at "safe" levels which will avoid adverse impacts to sensitive receptors. Various technologically feasible methods exist for control of acid oxide emission sources (e.g. scrubbers for sulfur dioxide sources, stack controls and/or combustion controls on stationary sources of nitrogen oxides, limitations on transportation sources, etc.). Once emissions of acid deposition precursors enter the atmosphere, prevention of deposition is not possible.

Remedial options include:

- Reduction of precursor emissions to levels which will allow natural and/or cultural recovery of chronically affected ecosystems and/or cessation of episodic acidification events.

- Once chronic acidification of the environment occurs, various remedial actions are available to attempt restoration of ecosystems and/or water supplies. Most of these options involve the addition of base cations to affected surface waters or watersheds (e.g. liming of lakes).

- Restocking of fisheries resources to affected surface waters following restoration of water chemistry.

Criterion 1: Public Awareness of Risk
Rating: 4

Numerous environmental organizations, citizen's groups and individuals have expressed views of concern, participated in monitoring activities to heighten awareness, and presented formal testimony expressing their concern. Both federal and state legislative bodies (as well as international bodies) have made inquiries into the threat of acid deposition and have proposed and passed legislation (in particular, legislation passed by the Washington

Legislature and legislation proposed by the Bush Administration and others in the U.S. Congress) to address this threat. In addition, acid deposition has been the subject of numerous media stories, and is popular in environmental curricula in schools. (NOTE: the status of legal action is uncertain; cases may have been filed, which would increase the rating for this criteria to "5".)

Criterion 2: Existing Legal Authority
Rating: 2

State and federal laws exist, but are not sufficient to control/prevent adverse impacts. These laws include the federal Clean Air Act and the state Clean Air Act.

Air pollution control laws are inadequate for control of emissions which are not posing a human health threat, and are inadequate for control of "grandfathered" emission sources. (Note that impending federal legislation will likely strengthen the federal laws for the expressed purpose of implementing acid deposition controls, and this may occur in the current session of Congress.)

The division of regulatory approaches for air versus water pollution control (i.e. the apparent lack of mechanisms for cross-media pollution control) definitely impacts the effectiveness of existing legal authority. (Also see discussion of this criterion in Ambient Air Pollution paper.)

Criterion 3: Existing Control Programs and Adequacy to Address Risks
Rating: 2

Control programs are in the "pilot stage" in the United States, and preferred control options for widespread implementation have not yet been chosen or implemented. Participation in control programs in this country are basically on a voluntary basis at this time. At the national level, most resources are still devoted to studying and characterizing the problem, with minimal resources currently devoted to controls. Virtually no state control program is in place in Washington (i.e. the rating for this criteria would be "1" if only Washington were considered), however, we are likely to be affected by a national program or at least experience some "spillover" effects. In Canada and Europe, control programs have matured to the level where they would receive a rating of "4" under this criteria.

Criterion 4: Availability of Risk Reduction Technology
Rating: 4

Proven technologies are available for risk reduction through control of major sulfur dioxide sources and stationary nitrogen oxide sources (though nitrogen oxide control technologies are less definitively proven). Implementing controls on existing sources will require fairly major investments in capital equipment and may present significant engineering challenges depending on the particular source to be controlled.

Transportation sources are the primary contributors to nitrogen oxides in the atmosphere, and control (i.e. risk reduction) technologies are more of a

mixed bag in this case. For instance, achieving reductions in precursor pollutants from automobile traffic is relatively proven technologically speaking, but it will require major social adaptations as well as public capital expenditures to be effective (less use of single-occupant vehicles, more use and more availability of public transit, more traffic-smart urban design, etc.)

Preventative type risk reduction technologies are readily available and limited only by availability of funding. These include certain technologies currently used in environmental monitoring programs designed for early warning of adverse effects and/or increased risk. Other monitoring technologies, such as those to measure dry deposition or acid fog and cloudwater are less definitively proven.

Criterion 5: Effectiveness of Risk Reduction Technologies
Rating: 5

It is estimated that greater than 75% of the precursor emissions which constitute the treat to resources sensitive to acid deposition could be adequately controlled if technologies were fully implemented.

Criterion 6: Costs of Implementing Risk Reduction Technologies
Rating: 5

Given the current state of knowledge concerning acid deposition in Washington, the most prudent risk reduction technologies for our state may be the less costly preventative ones, such as environmental monitoring designed to provide early warning of increased risk. It is estimated that implementing such preventative risk reduction technologies through 2010 could be accomplished at a cost of between $1 and $5 million. However, if emission controls on major sources of precursor air pollutants are implemented as a preventative measure, the costs would likely be much greater.

The estimated cost of implementing all proven control technologies in Washington through 2010, including emission controls for major stationary sources, would exceed $500 million. Implementing all types of available technologies in Washington is not justified by current knowledge of acid deposition effects, but could be justified in the future as total sources of precursor emissions increase or if adverse impacts not yet determined are documented by additional effects research.

Overall Controllability Rating: 4

An overall controllability rating of "moderate to high" is given recognizing that the most prudent risk reduction technologies will be the less costly preventative ones. Factors which tend to support this rating include the very high level of public awareness and the availability of proven risk reduction technologies. Also, international pressures and impending federal control actions and/or law strengthening appear to forecast an increase in controllability in the near future.

However, an overall controllability rating of "moderate" might be more

appropriate in consideration of the relatively high costs of implementing all available technologies and the lack of a demonstrated severe problem in Washington. As a practical matter, it seems we may not be sufficiently motivated to reduce a risk until that risk has caused severe damage or eminently threatens human life or life-styles.

Washington Environment 2010
Action Strategies Analysis Committee
Controllability Rating

Threat: Hydrologic Disruptions Risk: Ecological, Economic Damages

Control Options

1) Dams

- Prohibit construction of new dams or allow them only under strictly defined conditions.

- Abate existing impacts by requiring instream flow releases, fish passage facilities, and ramping rates. Require removal of dams that cannot otherwise be abated.

- Require mitigation of external effects of dams so as to reflect the full range of economic and social costs they impose.

- Use alternative means of supplying water and energy and controlling flood damages.

2) Withdrawals

- Augment low flows from existing or new storage.

- Conserve water by existing uses to reduce diversion requirement.

- Recycle water for non-potable uses.

- Artificially supplement impacted aquatic resources.

- Purchase and retire existing water rights.

- Enforce against the waste of water.

- Impose minimum flow requirements on new water uses.

- Subordinate existing uses to instream flows.

- Improve watershed management and restore impacted watersheds.

3) Construction and Flood Control

- Prohibit or more effectively control development in flood plains.

- Require mitigation for channel alterations.

- Require reestablishment of riparian vegetation and aquatic habitat in disturbed areas.

- Establish and enforce standards for riprap and bridge and culvert construction.

4) Forest Practices

- Prohibit or strictly control road building and logging in critical watershed areas.
- Require mitigation of aquatic and riparian habitat damage.
- Require significant uncut buffer strips along perennial streams.
- Use balloon and other less intrusive logging methods to minimize mid-slope road building.
- Prohibit clear cuts over a specified size, but encourage thinning and shelterwood cutting practices.
- Retire and revegetate spur roads and landings.
- Require and enforce replanting of clear cuts.
- Develop markets for red alder and other natural successional "weed" species and eliminate or limit herbicide spraying.
- Establish broad economic and environmental objectives for forest planning.

5) Irrigation Distribution and On-farm Practices

- Improve the efficiency of conveyance and water application to reduce diversions and to allow reallocation of water savings.
- Require mitigation of wetland losses due to efficiency improvements.
- Purchase and retire water rights, especially on marginally productive lands.
- Install modern fish passage and protective facilities on irrigation canals and ditches.

6) Dryland Agriculture

- Set aside areas with highly erodible soils and steep slopes.
- Require revegetation of abandoned farmland.
- Avoid cultivation in or near drainage channels.
- Adopt conservation tillage practices.
- Eliminate price supports for cultivation of marginal lands.

7) Livestock Grazing

- Fence riparian zones to control livestock access. Provide short access points for livestock watering or provide for watering outside the stream channel.

- Reduce stock densities or alter the rotation of grazing on overgrazed lands.

8) Urban Construction

- Prohibit or strictly control streamside development.
- Require or provide incentives for retention of riparian zone vegetation.
- Prohibit riprap of banks when a problem results from an owner's alterations of the riparian zone.
- Assure proper design and maintenance of sediment retention facilities.

9) Urban Development

- Retention of stormwater in natural wetlands and impoundments.
- Preservation of wetlands, ponds and lakes that control peak discharges.
- Preservation of groundwater recharge areas, riparian vegetation, and natural stream channels.
- Stream setback requirements.

10) Ground Water Withdrawals

- Prohibit new wells in alluvial zones likely to affect surface water or place minimum flow requirements on such wells.
- Prohibit ground water declines by denying new wells or manage declines to a acceptable rate.
- Require casing of wells to prohibit water migration between aquifer zones.
- Provide adequate supervision and monitoring of well construction and abandonment.
- Conserve water to delay or avoid need for new wells.
- Employ artificial recharge of aquifers using excess winter and spring surface water.

General

- Place burden of proof regarding impacts on the developer/user.
- Require that all impacts and costs be internalized and accounted for by new projects.
- Modify tax incentives, subsidies and other enticements that attract development in hydrologically sensitive areas.
- Employ rate structures that encourage water and power conservation.

- Tax resource use and pollution based on rate of use or pollution; use the resulting revenues to support more effective resource management and protection.

Ratings

Criteria # 1: Evidence of public awareness and concern regarding the identified risks. Rating = 5

Significant public controversy exists regarding all of the subelements discussed for this risk subject area. Additional dams and water withdrawals are viewed as necessary by utilities and agriculture but are adamantly opposed by environmental organizations which prefer strict water conservation. Land and resource management practices, particularly on public lands, are continuously challenged by environmental interests. Stream channel alterations, riparian grazing, silviculture and various agricultural practices have all been the subject of numerous lawsuits and legislative attention.

Criteria # 2: Existing legal authority. Rating = 3

Numerous existing laws apply in this risk subject area. Extensive laws now address water rights, flood control, contruction in the stream channel, and shoreline development. However these laws are generally written to avoid damaging economic interests. Some require the balancing of economic costs and benefits against environmental costs and benefits or contain major categorical exemptions. Some are ineffectively administered, insufficiently funded, or encounter political and legal obstacles to effective implementation. Attempts to enforce environmental laws sometimes results in legislative or judicial intervention. Agencies' efforts to protect environmental resources frequently collide with real or perceived private property rights over land, water and related resource values.

Some areas of state authority are preempted by federal authority. For example, hydropower development is almost exclusively controlled by a federal agency, the Federal Energy Regulatory Commission, that has historically been unresponsive to objectives other than maximum power development.

Criteria # 3: Existing control programs and adequacy to address identified risks. Rating = 3

Control programs exist at various levels of government for most of the subelements in this risk area, and many probably have adequate resources to do the job. (Some of the subelements are lacking control programs such as grazing on private land and water use under vested water rights.) However, the obstacles to effective implementation described in the previous section limit the ability of regulatory agencies to carry out their functions.

Criteria # 4: Availability of risk reduction technology. Rating = 3

Technologies are available to reduce environmental risk for some of the subelements. Mitigation of damages is possible in many streams that have been damaged in the past. For example, criteria for fish passage and protective facilities are well understood and much experience has been

gained with these devices in recent years. The same is true for excluding cattle from the riparian zone. Streams and aquifers are self healing given sufficient time and undisturbed opportunity. Some resource losses cannot be effectively mitigated if the impacting activity is undertaken, for instance the inundation of fish and wildlife habitat by an impoundment. Avoiding new impacts is the most obvious risk reduction strategy.

Criteria # 5: Effectiveness of risk reduction technologies. Rating = 3

Some technologies are relatively (but rarely completely) effective. For example fish passage and screening facilities can be designed to work well on low dams, but do not work well at high dams or large reservoirs. Even the most modern fish passage facilities result in some mortality or stress to the resource. Fish hatcheries, frequently used as mitigation for loss of natural habitat, have an inconsistent record of effectiveness. Experimentation in Oregon with excluding cattle from riparian areas in dry climates has yielded surprisingly effective results in improving aquatic conditions, low flows, ground water levels, and overall stock densities that can be supported. Uncut strips of timber along waterways appear to at least partially protect the viability of the aquatic environment. Retention ponds and preserving urban wetlands help ameliorate the accelerated runoff of water in developed landscapes. Minimum flow requirements are effective at retaining water in streams.

Criteria # 6: Costs to responsible persons of implementing risk reduction technologies. Rating = 2

The Bonneville Power Administration, other federal agencies, and the State are currently investing many millions of dollars in fish passage protective facilities on scores of dams and diversions on the Columbia and Snake Rivers and on tributaries such as the Yakima and Wenatchee Rivers. In the Yakima basin alone, over $30,000,000 has been authorized by Congress for expenditure on such facilities. Up to one-half billion dollars may be expended in the Yakima basin over the long term on water conservation and additional water storage facilities to improve flows and other fish habitat conditions.

The costs of forgoing surface water development, timber cutting, cattle grazing, and flood control activities to avoid impacting water related resources is unknown but is obviously significant.

Criteria # 7: Overall controllability of the identified risks. Rating = 3

The prospects for effective control of environmental risks associated with hydrologic disruptions is uncertain. The outcome is more a function of public attitudes and priorities than of control technologies. Continued population growth and economic development, especially at the current pace, will inevitably increase the risk to water resources unless a new ethic emerges. In the long term, society needs to address the relationship between private property rights and the public interest. Emerging legal theories, including Indian treaty environmental protection rights (United States v. Washington, Phase 2) and the public trust doctrine (Orion Corp. v. State of Washington) may signal changes that will strengthen the legal framework for environmental protection and efforts to redress past environmental damages.

Washington Environment 2010
Action Strategies Analysis Committee

Risk Controllability Rating

Threat: Active Hazardous Waste Sites

Risk: Human Health
Ecological
Economic

Active hazardous waste facilities are those facilities which require a permit to operate under the Federal Resource Conservation and Recovery Act (RCRA) and/or the state Hazardous Waste Management Act. These facilities are regulated by an extensive set of regulations which were developed to comprehensively control management practices in order to minimize human health and environmental risks.

The associated "risk assessment" on active hazardous waste sites highlighted an area within the "scope" of RCRA that needs further evaluation; that is, the 3,500 generators of hazardous waste in Washington State who by either the volume of waste they generate or by their handling method do not need a permit to operate.

The significance of the generators cannot be overlooked and should be included in future 2010 studies. Although a "risk assessment" was not done on generators per se, there are a number of actions which are suggested to reduce the risk generators pose to human health and the environment. These are attached as a supplement to the active hazardous waste site risk controllability rating.

Control Options

- Technical Control

  Require Best Available Control Technology (BACT) for all air emission sources from tanks, treatment systems, and incineration systems regardless if they are new or existing.

  Require all waste piles to be enclosed in buildings.

- Administrative/Regulatory

  Require health and environmental risk assessments be done as part of the permitting process.

  Increase personnel training requirements for personnel managing hazardous waste.

  Streamline decision making in response to human health and environmental issues/problems.

  Require source reduction at waste generation points.

Simplify state regulations to allow for better coordination with the Federal RCRA program and increase understanding of regulatory requirements by industry and the public.

- o Resource

  Increase funding for hazardous waste compliance and permitting to allow for more timely and focused efforts on hazardous waste management facilities.

- o Educational

  Undertake a comprehensive program aimed at hazardous waste management facilities informing them of regulatory requirements and the environmental and public health concerns of hazardous waste.

  Expand the technical outreach program for management facilities to assist in their development of source reduction programs and better management practices.

Criteria and Rating

I. Evidence of public awareness and concern regarding the identified risks. Rating 4

There is considerable public and industry awareness on hazardous waste issues with those organizations/industries in the mainstream politic. In addition, major legislation has been passed at the state level to regulatory control the management of these sites.

II. Existing legal authority. Rating 4

There is considerable legal authority outlining the steps necessary to safeguard public health and the environment. Current law, however, does not subject many hazardous waste facilities to environmental monitoring. (Those subject to an EIS are the exception).

III. Existing control programs and adequacy to address identified risks. Rating 3

Considerable program development has occurred to strictly regulate active hazardous waste sites. What is lacking is a required comprehensive review of the potential environmental effects these facilities may have. Resources to inspect and permit these sites are severely limited. Of more importance are the estimated 3,500 generators across that state that need attention because of their diverse nature, their typical lack of resources due to their small size, and less restrictive regulatory requirements they must adhere to.

IV. Availability of risk reduction technology. Rating 4

There are technologies and alternative designs available for most aspects of waste management.

V. Effectiveness of risk reduction technologies. Rating 4

Given the fact that technologies are available for most aspects of hazardous waste management and that EPA is requiring Best Demonstrated Available Treatment Technologies for all categories of hazardous waste by 1990, the risk reduction technologies, "if fully implemented, have the potential to address a majority of the identified risks (50-75%)."

VI. Costs to responsible persons of implementing risk reduction technologies. Rating 4

A very tentative estimate of the cost to the regulated community of implementing risk reduction technologies is about $5 million to $50 million ($2.5 million annual average). This estimate is based on best professional judgments on equipment and design changes necessary to meet state and federal regulatory requirements.

VII. Overall controllability of the identified risks. Rating 4

The controllability of the risks from active hazardous waste sites is probably moderate to high. The basis for this rating is the cumulative probability that the risks can be controlled, based on the awareness of the threats, existing federal and state statutory authorities, availability, and effectiveness of risk reduction technologies. These factors could lead to controlling the risk to a high degree. However, the limited resources in the existing control program and the lack of risk assessment investigations to assess short- and long-term impacts may limit compliance and result in only moderate control of the risks.

Washington Environment 2010
Action Strategies Analysis Committee

Supplement to Active Hazardous Waste Site
Risk Controllability Rating

Threat: Generators of Hazardous Waste

Risk: Human Health, Ecological and Economic

- **Administrative/Regulatory Actions**

  Streamline decision making in response to human health and environmental issues/problems.

  Require source reduction at generation points.

  Simplify state regulations to allow for better coordination with the Federal RCRA Program and increase understanding of regulatory requirements by industry and public.

- **Resource Actions**

  Increase funding for focused hazardous waste compliance and environmental analysis on generators.

- **Educational Actions**

  Undertake a comprehensive program aimed at hazardous waste generators informing them of regulatory requirements and the environmental and public health concerns of hazardous waste.

  Expand technical outreach programs to generators to assist them in their development of source reduction and better management practices.

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Washington Environment 2010
Action Strategies Analysis Committee

Risk Controllability Rating

Threat: Inactive Hazardous Waste Sites Risk: Health, Ecological, Economic Damages

Control Options

o Non-technical control options include:

- Fencing and other barriers to access.
- Public availability of information on confirmed inactive hazardous waste sites.
- Extension of legal liability to lending institutions, increasing caution involved in providing funds to purchasers of property.
- Evacuation of human or domestic animal populations.
- Posted notices in places where people customarily go for fish and shellfish.
- Provision of bottled water.

o Technical control options vary widely depending on the type of contaminant, media affected, exposure pathways, and species present.

- Installation of alternative water supply system.
- Removal and offsite disposal or treatment of contaminated soils, sludge, etc.
- Incineration of contaminated materials.
- Containment of wastes (e.g., capping, slurry walls).
- Removal of volatile contaminants via air stripping, carbon absorption, etc.
- Extraction of potentially explosive or lethal gases.
- Installation of monitoring wells.
- Demolition and disposal of contaminated buildings.
- Recovery of reusable substances.

Criteria #1: Evidence of public awareness and concern. Rating: 5

Public awareness and concern are high. One expression of that interest was passage of the Model Toxics Control Act through an initiative process ratified by the electorate. Media interest is high, responding to the interest of the public and at the same time serving to maintain it. Individuals and organizations have brought suit against firms and governmental entities for alleged failure to resolve the threat or risk to the complainant's satisfaction.

Criteria #2: Existing legal authority. Rating: 4

Federal law addressing inactive hazardous waste sites as been on the books since 1980. The Comprehensive Environmental Response, Compensation, and Liability Act was reauthorized in 1986 as the Superfund Amendments and Reauthorization Act. Regulations for CERCLA/SARA are in place.

Washington state law addressing inactive hazardous waste sites in a comprehensive manner is much more recent. In 1987, the Washington State Legislature passed legislation. Implementation got underway. The following fall, voters selected an alternative proposal. The effective date of the current law, the Model Toxics Control Act, was March 1, 1989. Regulations to implement it are now being drafted. The new state law has not yet been addressed definitively in the judicial system.

Criteria #3: Existing control programs and adequacy to address identified risks. Rating: 3

For sites meeting certain federal criteria, the laws and funding mechanisms are in place to control health and ecological risk to a moderate degree.

For sites which are the sole responsibility of the state, the enforcement tools are adequate, but the regulatory framework is not yet in place. State law provides a dedicated tax to fund cleanups, but the revenues have to date fallen short of expectations. The result is that state programs are operating with significantly fewer resources than necessary.

Criteria #4: Availability of risk reduction technology. Rating: 3

Technologies to control risk are available for some but not all contaminants and media. The Environmental Protection Agency, through its SITE (spell out) program, is attempting to test innovative methods. Barriers to new methods are cost, unknown results and permit processes that do not easily accommodate unproven methods.

Criteria #5: Effectiveness of risk reduction technologies. Rating: 3

Many risk reduction technologies are very effective. Some may be effective but prohibitively expensive. And for some contaminants and in some media, no technology is adequate. Overall, risk reduction technologies have a realistic potential to address a substantial portion of the identified risks.

Criteria #6: Costs to responsible persons of implementing risk reduction technologies Rating: 2

The cost of cleaning up inactive hazardous waste sites varies widely. At the high end is the Western Processing site, now estimated to cost $60 million. Three of the landfills on the federal Superfund list for Washington state will together cost $80 million. Considering the number of sites where contamination is confirmed or suspected, the total cost to responsible parties will be over $500 million.

#7: Overall controllability of the identified risks. Rating: 4

The greatest factor in controlling the risks of inactive hazardous waste sites is public awareness and concern, which has now been institutionalized in law.

Washington Environment 2010
Action Strategies Analysis Committee
Controllability Rating

Threat: Non-Hazardous Waste Sites Risk: Human Health and Ecological, Economic

Control Options

- o Legislative:
  - Study the possibility of establishing by law a statewide solid waste management authority to specifically conduct planning, siting, designing, and operating (under contract) regional solid waste landfills and incinerators.
- o Resources:
  - Fully fund efforts to apply stringent siting, design, operating, maintenance, closure, and financial assurance standards for solid waste incineration and landfilling facilities.
- o Public Information and Education:
  - Encourage to the maximum extent possible the best management practices for various waste categories such as sewage sludge, dredge spoils, construction debris, yard waste, etc..
  - Set up a center for the study of solid waste management policies in a state university to strengthen the research and development ties between the state, local government, private industry, and universities.

Criteria and Rating

I. Evidence of public awareness and concern regarding the identified risk. Rating = 5.

A rating of 5 has been assigned in light of considerable involvement and input by the public environmental organizations, private industry, and the Legislature. In addition, legal actions of various sorts have been filed against local and state agencies.

II. Existing legal authority. Rating = 3.

A rating of 3 has been assigned since technical standards to manage solid waste are adequate but are not being fully implemented due to limited resources. In addition, there are some gaps in existing law pertaining to enforcement and permitting authority at the state level.

III. Existing control programs and adequacy to address identified risks. Rating = 3.

The State Minimum Functional Standards for Solid Waste Handling, WAC 173-304, were passed in 1985 and have moved beyond initial implementation, but have not yet been fully implemented, since they are operating with less than 25 percent of estimated needed resources.

IV. Availability of risk reduction technology. Rating = 4.

Generally speaking, there are many available technologies to address the risks from solid waste handling. Recycling, incineration, and landfilling have been with us for many years.

The areas where technology needs further review are in reuse or containment of ash residue, and long term effectiveness of landfill liners and caps.

V. Effectiveness of risk reduction technologies. Rating = 5.

The risk reduction technologies such as methane controls, groundwater controls, surface water controls, as well as incineration if fully implemented, have the potential to essentially address the identified risks.

VI. Costs to responsible persons of implementing risk reduction technologies. Rating = 3.

As a result of a 1987 Cost Analysis Study of the New Solid Waste Landfill Standards, it was estimated that it would cost $750,500,000 for new landfill construction over the next 20 years (38 million annual average), as well as costs for state and local agencies, to effectively manage solid waste. Added reduction technology costs such as treatment, recycling, and waste reduction could decrease this cost considerably.

VII. Overall controllability of the identified risks. Rating = 4.

The controllability of the risks from non-hazardous waste sites is moderate to high. The basis for the above rating is the cumulative likelihood that the risks can be controlled based on the awareness of the threats, availability of technology, and the effectiveness of the technology. However, the costs to the regulated community and uncertain statutory authority are substantial enough that this may undermine compliance and result in only moderate control of the risk.

WASHINGTON ENVIRONMENT 2010
ACTION STRATEGIES ANALYSIS COMMITTEE

CONTROLLABILITY RATING

Threat: Materials Storage

Introduction

Materials storage, in the Washington Environment 2010 project, includes the storage of petroleum and chemical products, in both underground and above-ground tanks. For the purpose of this controllability exercise, the threats and control options for above and belowground tanks are addressed separately, because the regulatory process for each is at a very different stage. However, in the summary table presented with this report, only the ratings for underground storage tanks are presented, since these tanks are currently viewed as the primary threat.

Underground storage systems (i.e., tanks and their associated piping) are subject to federal regulations which took effect at the end of 1988, and applicable state regulations will be developed by mid-1990. However, there is presently no comprehensive or specific program to regulate aboveground storage systems (see controllability rating criteria). Thus, the control options which are presented for each of the categories are based on these circumstances. The options identified for underground storage systems are essentially those which are now required by federal law; the control options for aboveground storage systems are the tentative recommendations which were made in a 1989 Ecology report to the legislature (Aboveground Storage Tanks in Washington State, Publication 89-1).

Underground Storage Systems

Risk: Human Health, Ecological and Economic

Control Options

Requirements for existing tanks and piping -

- Upgrade or close the system:
    1. Release detection devices and methods;
    2. Corrosion protection methods;
    3. Spill and overfill prevention devices;
    4. Secondary containment (for chemical storage systems);
- Record-keeping;
- Reporting; and
- Prompt response to releases.

Requirements for new tanks and piping:

- Proper installation;

- Release detection devices and methods;
- Corrosion protection methods;
- Spill and overfill prevention devices;
- Record-keeping;
- Reporting; and
- Prompt response to releases.

Education and technical assistance directed to regulated community:

- Periodic newsletter with regulatory and technical information;
- Availability of videos, speakers, etc.; and
- Toll-free telephone lines to provide information.

Evaluation of the Criteria

I. Public Awareness of the Risk. Rating = 4

A rating of 4 was assigned because, although the legislature has done more than made inquiries (which is an element of rating number 4), apparently no legal actions have been filed because of failure to resolve the risk (as in rating number 5). The legislature passed a law in the 1989 session directing Ecology to establish a comprehensive regulatory program to address underground storage tanks (USTs). This was based on the finding of the legislature that "leaking underground storage tanks containing petroleum and other regulated substances pose a serious threat to human health and the environment."

A number of interested organizations played a role in the formulation and passage of the UST legislation, and there have been numerous print media articles on the subject.

II. Existing legal authority. Rating = 4

A rating of 4 was assigned, although the reality is actually midway between ratings 3 and 4. Rating number 3 states, "state and/or federal laws exist and are not obviously inadequate, but have not yet been implemented" and rating 4 states that the applicable law "is being implemented (e.g., implementing regulations adopted)." In this regulatory area, federal implementing rules have been adopted (40 CFR Part 280) but EPA does not anticipate actually implementing them (in the sense of obtaining the resources to adequately enforce the rules); the apparent intent of Congress, and certainly of EPA, is to delegate enforcement responsibility to the states.

A state law (HB 1086) passed in the 1989 session directs Ecology to establish an UST regulatory program which is consistent with, and no less stringent than, the federal program. Ecology's rules are to be effective by July 1, 1990.

III. Existing control programs and their adequacy. Rating = 2

As noted above, a federal UST regulatory program does exist, but it lacks adequate resources for enforcement. Since the rules just became effective in December 1988, the program is "just beginning to be implemented" and it is "operating with less than 10% of the estimated resources needed to address the threat." However, the public awareness which has been created as a result of the federal program is apparently leading to substantial compliance, as well as many UST closures.

Ecology's program will not be fully staffed until early in FY 92. The full anticipated staffing of 39 FTEs may be sufficient to address the threat, depending on how many more tanks are identified.

IV. Availability of risk reduction technology. Rating = 4

Generally speaking, there are many available "off-the-shelf" technologies to address the various technological aspects of controlling risks from USTs. This is particularly true regarding leak detection and overfill and spill prevention devices. There is a continually growing number of such products being introduced as marketers recognize the commercial potential of the requirements in the new federal UST rules. There are also various products available for corrosion protection; for existing tanks these would generally be one of two types of "cathodic protection". Tanks which meet the new tank standards are also readily available.

The area where technology may be lacking or where "technologies must be borrowed and adapted for application" (as in rating number 4) is leak detection for chemical storage systems. Apparently many of the methods available for petroleum storage systems will not necessarily detect certain chemical leaks (e.g., vapor monitors). However, technologies are available for some chemicals, and new methods are under development.

V. Effectiveness of risk reduction technologies. Rating = 5

If <u>full</u> implementation implies that all of the regulated community is <u>aware of and in compliance</u> with rules requiring the risk reduction technologies, these technologies may have a realistic potential to address a majority of the risks (i.e., 50-75 % , or more) by the end of 1993. This is the date by which all regulated storage systems must employ a leak detection method under 40 CFR Part 280.

By 1998, the risk reduction technologies, "if fully implemented, have the potential to essentially address the identified risks (i.e. > 75 % risk reduction)." By this date, all tanks regulated under 40 CFR Part 280 must be upgraded to new tank standards. With corrosion protection, leak detection, and overfill and spill prevention, leaks from storage systems should largely be prevented, and those that do occur should be promptly identified and stopped.

VI. Costs to responsible persons to implement risk reduction. Rating = 3

A very tentative estimate of the cost to the regulated community of implementing the identified risk reduction technologies (control options) is about $250 million, to be expended over a ten-year period (under the

federal rules, tanks must be upgraded, replaced or permanently closed by 1999). This translates to an average annual cost of $25 million each year for ten years. This estimate is extrapolated from an analysis which was prepared for legislative staff during the 1989 session. The $250 million figure is based on the assumption that approximately one third of the presently regulated tanks (10,000 of 30,000) will be closed rather than replaced or upgraded. If all tanks presently registered were replaced (rather than closed or upgraded) the estimated cost would be approximately $400 million (or $40 million annually for ten years).

VII. Overall controllability of the identified risks. Rating = 4

The controllability of the risks from USTs is probably moderate to high. Based simply on a quantitative average of the previous criteria ratings, the score would be 3.666 (total score [22] divided by 6). However, the total score is "artificially" depressed by the fact that the existing control program and its adequacy received a low score (2) because it is not yet implemented. In perhaps three years this score would rise (presumably) to at least 4 and the average score would be at least 3.8.

Average score aside, the basis for the above rating is the cumulative likelihood that the risks can be controlled, based on the awareness of the problem, existing statutory authority, and availability of the relevant technology. These factors could lead to controlling the risk to a high degree; however, the costs to the regulated community are substantial enough that this may undermine compliance and result in only moderate control of the risk.

Aboveground Storage Systems

Risk: Human Health, Ecological and Economic

Control Options

Preliminary indications, based on a survey of aboveground petroleum storage tanks (ASTs) in the state, and a review of current applicable laws and recommended practices, suggest the following control options may be appropriate for these tanks:

- Specific standards for construction and tightness testing;
- A requirement that ASTs which are disassembled and reconstructed meet standards for new tanks;
- A requirement that all AST facilities have Spill Prevention, Control and Countermeasure Plans;
- Standards for construction of containment dikes;
- A requirement that containment areas have impermeable surfaces;
- A requirement that drainage from containment areas be prevented from escaping into storm water systems;

- Requirements that inventory control methods and overfill prevention devices be employed;
- Specific requirements for corrosion prevention; and

- Establishment of recommended practices for transfer operations.

Given the preliminary nature of the above recommendations, the most important control option at present would be to obtain and commit adequate resources to determining the following:

- The extent of the potential problem, in more detail, <u>especially regarding chemical ASTs</u>;

- Whether the above measures are appropriate to all ASTs, or only specific categories (e.g., based on size, type or location);

- Whether more extensive requirements are necessary, such as the comprehensive regulatory program now being implemented for underground storage tanks; and

- The likely costs of the program.

<u>Evaluation of the Criteria</u>

I. Public Awareness of the Risk. Rating = 2

A rating of 2 was assigned, although the reality is somewhat ambiguous. While a major spill from an AST in Pennsylvania in early 1988 has spurred Congress to consider various legislation to control ASTs, none has yet been passed. Local jurisdictions and environmental organizations have become concerned about underground storage tanks being replaced by those aboveground, but there does not appear to be significant public awareness regarding the issue.

The state Legislature has made inquiries; a bill was passed in the 1988 session requesting a report on aboveground tanks. However, this inquiry was not specifically "related to threat and risks", it was a request for information regarding the appropriate approach to regulating ASTs. The basis of the inquiry was based more on the anticipation that petroleum ASTs would be subject to a program required under the then existing cleanup law than an assumption that ASTs necessarily pose an environmental problem.

II. Existing legal authority. Rating = 3

There are existing state and federal laws pertaining to ASTs. The Uniform Fire Code, which is adopted by reference as part of the State Building Code, contains requirements for ASTs, and the Federal Clean Water Act requires Spill Prevention, Control and Countermeasure (SPCC) Plans for certain AST facilities. The requirements under these laws are not necessarily obviously inadequate, but they are not enforced consistently enough to ensure compliance.

III. Existing control programs and their adequacy. Rating = 2

As noted above, state and federal requirements do exist, but they are not adequately enforced. Also, no specific AST program exists. Certainly part of the problem is that there are not sufficient resources for enforcement.

IV. Availability of risk reduction technology. Rating = 4

There are many available "off-the-shelf" technologies to address the various technological aspects of controlling risks from underground tanks, and much of this technology would probably be applicable to ASTs as well. There is an increasing number of leak detection and overfill and spill prevention devices available. There are also various products available for corrosion protection. However, for the most part these technologies are not presently required for ASTs.

As with underground tanks, the area where technology may be lacking or where "technologies must be borrowed and adapted for application" (as in rating number 4) is leak detection for chemical storage systems. Apparently many of the methods available for petroleum storage systems will not necessarily detect certain chemical leaks (e.g., vapor monitors).

V. Effectiveness of risk reduction technologies. Rating = 3

A rating of 3 has been assigned, although because of the nature of the present situation, the reality is difficult to assess. As noted under the previous criteria rating, sophisticated technological solutions are for the most part not presently required. Presumably, if the control options suggested here were fully implemented, a substantial portion of the risk would be addressed. If, on the other hand, it were determined that the full gamut of the technological control options (as presented for underground tanks) should be required and this program was fully implemented, the vast majority of the risks would probably be addressed.

VI. Costs to responsible persons to implement risk reduction. Rating = 3

This is unknown, and obviously merits further investigation. The rating of 3 is based on these assumptions:

1. There are less aboveground than underground tanks (the current estimate is 10,000, compared to 40,000);

2. ASTs are more accessible than underground tanks; and

3. The control options identified here are generally less costly than those being required for underground tanks.

Given these assumptions, the estimates for underground tanks (250 and 400 million dollars) were divided by four, with the result divided by two, giving a range of $31 million to $50 million. Of course, these estimates may be quite erroneous.

VII. Overall controllability of the identified risks. Rating = 3

The controllability of the risks from ASTs is probably moderate to high. However, a rating of 3 was assigned (moderate controllability) because of the present circumstances: (1) the magnitude of the risk is not clear, especially concerning aboveground chemical tanks (most chemical storage tanks <u>are</u> aboveground; (2) there presently is no program to specifically address ASTs and while one may be on the horizon, that horizon is likely to be at least two to three years in the distance; and (3) the current requirements are not well enforced.

Despite the present circumstances, it is likely that an AST program will eventually be established. If it includes, at a minimum, the control options noted in this exercise, and if they are fully implemented, it is likely that the risks from ASTs can largely be controlled.

Washington Environment 2010

Action Strategies Analysis Committee

Controllability Rating

Threat: Sudden and Accidental Releases

Risk: Human Health, Ecological, Economic Damage

I Introduction

The sudden and accidental release of hazardous materials and petroleum products poses a serious acute risk to human health in Washington State. Extremely large releases can capture the attention of the entire world. Witness the concern over the Bophal, India Union Carbide release which killed and injured several thousand people and the recent devastating Exxon Valdez spill.

In Washington state, accidental releases rank as one of the greatest acute threats to human health in the environmental arena. Chronic affects may be present, but not measurable to the general population. However, chronic affects to Ecology response personnel have been noted.

The ecological disasters of recent major oil spills in Washington state, while not fully measurable economically, have seriously affected some of the state's most pristine national wildlife refuges. The 1989 Legislature recognized the serious threat and inability of the state to recoup its costs with the passage of legislation which increased the penalty for reckless or intentional discharge of oil to $100,000 per day the material is in the water. The legislation also changed the method of assessing damages to state resources, allowing the state to assess up to $50 per gallon of oil spilled. This valuation and penalty in the case of the recent Nestucca barge spill could have resulted in a damage assessment of up to 11 million dollars and a penalty, should the discharge have been found to be reckless, (this is strictly a hypothetical example) of up to five million dollars.

The controllability of these impacts is at two levels -- 1) prevention; and 2) after-the-fact control, countermeasures and evacuation. Prevention is emphasized in the control options listed below due to the large potential benefit. However, complete prevention can only occur with the cessation of all hazardous material and oil transportation and storage! A more likely scenario is increased federal and state regulation; and industry self-monitoring, which may incrementally reduce the possibility of the releases by, perhaps 10%.

Increasing the federal, state, local and industry response capability would function to more quickly mitigate the effects of the releases and in the case of acute human health impacts (due highway hazardous material transportation incidents), may significantly reduce potential mortalities. However, overall, an improved response capability would

not be anticipated to have a dramatic beneficial effect, particularly in very large oil spills. It is not anticipated that spills on the order of the Exxon Valdez can be effectively contained or otherwise controlled with current technology. Placing resources in response capability results in a more accurate targeting of money and effort while prevention (which may be less cost effective) attacks the cause of the problem. Both types of controls are necessary.

II Control Options

(In addition to an adequate, quick response capability to maximize control, countermeasures and clean up measures.)

- Marine Transportation-Related
  - Expand USCG Vessel Tracking System
  - Increase number of pilots on-board
  - Improve pilotage licensing requirements
  - Increase USCG inspections
  - Require mandatory substance abuse testing
  - Require double hulls
  - Require state or USCG approved vessel-specific spill control plans
  - Require that vessels carry equipment necessary to implement spill control plans (e.g. containment booms)
  - Place seasonal or geographical restrictions on movements of tankers and barges; place limitations on size or cargo capacity of tankers/barges
- Land Transportation-Related
  - Stronger state and federal rail and trucking standards
- Fixed-Facility Related
  - Require automatic cutoff safety valves at loading facilities
  - Require warning or emergency alarms (e.g. overflow alarms)
  - Require approved spill control and containment plans
  - Require containment equipment be available to implement spill control and containment plans

III Ratings

The emphasis of the following ratings is upon marine transportation releases which have captured the attention of the public due to recent events.

Criterion I: Public Awareness Rating = 4

Both the State Legislature and the Washington Congressional Delegation have held public hearings and introduced state and federal legislation. Media attention has been extensive, with particular emphasis on marine petroleum spills.

Criterion II: Existing Legal Authority Rating = 2

Some State and Federal authorities exist, but are obviously inadequate and are not sufficiently implemented to control relevant risks. Also, additional authorities are needed to better control risk factors, but may never completely control the risks.

Criterion III: Existing Control Programs Rating = 3

Control Programs exist and have been implemented to a limited degree, however, resource constraints have not resulted in adequate action particularly with respect to prevention.

Criterion IV: Availability of Risk Reduction Technology Rating = 3

Some technologies exist, but are little changed since the late 1960's. New technologies are needed.

Criterion V: Effectiveness of Risk Reduction Technologies Rating = 3

Risk reduction technologies have potential for addressing 25 - 50% of risks, if fully implemented.

Criterion VI: Cost of Implementing Technologies Rating = 2

This cost estimate is not specific to Washington State, as suggested prevention strategies may require stronger national transportation standards. This estimate has a high degree of uncertainty. It is partially based upon the cost of implementing double hulls on oil takers passing through Washington waters.

Criterion VII: Overall Controllability Rating = 3

Moderate overall risk controllability rating.

WASHINGTON ENVIRONMENT 2010
ACTION STRATEGIES ANALYSIS COMMITTEE
CONTROLABILITY RATING

THREAT: LITTER RISK: ECOLOGICAL & HUMAN HEALTH

Control options:

Legislation

Stiffer penalties for littering and uncovered loads. Uncovered load legislation has failed to pass on two occasions.

Require best management practices for medical wastes.

Enforcement

Coordinate more closely with law enforcement officials to ensure enforcement of litter laws.

Public Education

Provide educational programs in schools and at public events to promote awareness of environmental problems caused by litter and marine debris. Focus on behavior modification.

Anti-litter and marine debris promotional campaigns including cooperation with retail and manufacturing industries.

Public Involvement

Encourage public involvement in prevention programs, as well as litter pickup programs and marine debris beach cleanups.

Grants

Provide funds to local governments for prevention and cleanup of litter and marine debris.

Waste Reduction and Recycling

Encourage waste reduction and recycling. Aid in developing markets for recyclable materials through state procurement.

Encourage industry to design for recyclability at end of product use. Encourage industry to include recyclables in their manufacturing process.

Encourage consumer and industry choices to reduce packaging waste. Consider product substitutions, changes, or bans.

I. PUBLIC AWARENESS OF RISK (Rating = 4)

We receive ongoing formal comments, complaints and media coverage, as well as legislative inquiries related to litter environmental problems.

II. EXISTING LEGAL AUTHORITY (Rating = 2)

Model Litter Control and Recycling Act (70.93).

Water Pollution Law (90.48).

Shoreline Management Act.

III. EXISTING CONTROL PROGRAMS' ADEQUACY (Rating = 2)

Coast Guard enforcement of marine plastics pollution research and control act began January 1989.

NOAA is monitoring marine debris problem.

Washington State Marine Plastic Debris Interagency Task Force has outlined an action plan. Implementation is in early stages.

Ecology Youth Corps employs 400 youth per year statewide to pick up and remove litter from public areas of the state. This is a fully developed program based on available funds. The more cost effective solution is through education programs.

Model Litter Control and Recycling Act (70.93) is rarely enforced and the penalties are not sufficiently punative.

Water Pollution Law (90.48) is rarely enforced for marine debris pollution prevention.

Shoreline Management Act is inadequate to control the threats of marine debris.

IV. AVAILABILITY OF RISK REDUCTION TECHNOLOGY (Rating = 4)

Options such as legislation, enforcement, public education, public involvement, grants and recycling programs are widely available but require time and experimentation to fit individual situations.

V. EFFECTIVENESS OF RISK REDUCTION TECHNOLOGY (Rating = 4)

Since behavior modification is the key to litter and marine debris reduction, we could expect to reduce risks by 50-75%.

VI. COSTS TO IMPLEMENT RISK REDUCTION TECHNOLOGIES (Rating = 3)

Litter accumulation is an ongoing problem. No particular dollar amount can be calculated to achieve total control. A 5-50 million dollar campaign involving pick up and removal and education would provide a great deal of short and long term reductions in generation rates.

VII. OVERALL CONTROLABILITY OF RISKS (Rating = 3)

Overall risk controllability for litter and marine debris is rated moderate due to the fact that success depends on changing individual human behavior patterns, and market factors affecting recycling viability.

Washington Environment 2010
Action Strategies Analysis Committee

Controllability Analysis

Threat: Wetlands Loss & Degradation

Risk: Ecologic and Economic

Introductory Remarks
This wetlands controllability analysis focuses strongly on wetlands loss. First, loss is deemed a higher risk than degradation, and second, there is no good quantitative information describing the nature and extent of degradation. Degradation is none-the-less a concern to wetlands managers.

Control Options

Regulatory

Enhanced enforcement of Section 404 of the federal Clean Water Act.

Amendment of local Shoreline Master Programs to provide enhanced wetlands protection to the extent enabled by the state Shoreline Management Act.

Adoption of local clearing and grading regulations which prohibit wetlands dredging or filling.

Adoption of local flood plain management regulations which prohibit filling in riparian wetlands.

Adoption of a state Wetlands Management Act similar to that proposed to the 1989 Legislature.

Education

Continued funding for local Wetlands Watch programs which educate citizens as to proper and improper development and construction techniques in and near wetlands.

Implementation of an environmental education program in the secondary school system which includes elements on the values of wetlands.

Fostering local Adopt-A-Stream programs which include an element to protect riparian wetlands.

Fostering local Adopt-A-Beach programs which include an element to protect marine or estuarine wetlands.

Purchase

Fee or less than fee purchase by local government for open space or storm water management purposes.

Fee or less than fee purchase by state resource agencies for open space or habitat values.

Fee or less than fee purchase by local land trusts for any purpose authorized by their Articles of Incorporation.

Landowner Incentives

Federal income tax incentives for donation or less than market value sale, in fee or less than fee.

Federal farm programs such as specific provisions of the 1985 Food Security Act: Wetlands Conservation (Swampbuster) provisions, Conservation Reserve Program, or Farm Debt Restructure and Conservation Set-aside Program.

State Open Space Act property tax incentives for Agricultural Open Space and "Open Space Open Space."

Private incentives from organizations like Ducks Unlimited, e.g. rental incomes for conservation set-asides.

Criteria 1: Public Awareness of Risk. Rating = 5
The public's awareness of the risks of wetlands loss and degradation clearly warrants a rating of 5.

Wetlands protection is high on the agenda of the Washington Environmental Council and many of its member organizations. Additionally, the Wetlands Management Act introduced to the 1989 Legislature, received strong support from the environmental community. Wetlands Watch, a volunteer monitoring program initiated by the Puget Sound Water Quality Authority, is strongly supported by the environmental community.

Wetlands loss and degradation has been opposed by citizen groups throughout the Puget Sound area for a variety of reasons. In the southwest Snohomish - northwest King counties region, citizen groups have protested wetlands loss out of concern for the loss of the flood water storage value of wetlands. In Renton, citizens reported and protested the apparent -- and later proved to be -- improper filling and development of an old growth riparian wetland. In Kitsap County there have been a number of controversies regarding development on and near wetlands in the Silverdale and Poulsbo areas. In Thurston County there has been a periodic and long term controversy, dating back to the mid-1970s, regarding development on and adjacent to the Grass Lake wetlands.

Sportsmen's groups also support protection and preservation of wetlands. Ducks Unlimited, in recent years, has added protection of domestic wetlands to its traditional agenda of preservation of Canadian wetlands. The Northwest Steelhead Chapter of Trout Unlimited has actively supported the protection and preservation of wetlands, particularly riparian wetlands. The Duck Stamp Bill, which established a special waterfowl hunting fee with proceeds directed towards habitat preservation -- including wetlands -- was successfully supported by sportsmen's groups.

The land development community, which opposed the Wetlands Management Act in its proposed form, has acknowledged the value of certain wetlands for certain purposes, particularly for storm water management. Their opposition was based on other issues such as the breadth of the proposed legislation.

Criteria 2: Existing Legal Authority. Rating = 2
The selection of a rating of 2 regarding existing legal authority is the result of "averaging" a number of considerations. Some wetlands are completely unregulated and unprotected (rating of 1), while others are protected by proven regulations (rating of 5).

At one extreme, the wetland protection measures of Section 404 of the federal Clean Water Act (CWA) have not only been upheld by case law, but its import has been strengthened beyond the meaning originally interpreted by the enforcing agency, the US Army Corps of Engineers. Here, a rating of 5 could be awarded. However, Section 404 regulates only wetlands filling, not dredging or similar degrading activities, thus severely diluting a potential 5 rating. Additionally, Nationwide Permit 26 allows up to 0.99 acre of fill in wetlands which are not associated with streams of 5 cfs or greater average annual flow; the cumulative effects of these one-acre fills in Washington is considered significant.

Similarly, the state Shoreline Management Act (SMA) has been upheld by case law. However, the SMA was never intended to protect wetlands; rather, it was intended to manage shoreline development. Furthermore, the wetland protection features of SMA are limited to jurisdiction over wetlands associated with lakes of 20 acres or more surface area, or streams of 20 cfs or more average annual flow. Again, a potential rating of 5 is severely diluted by the limited applicability of the SMA to wetlands.

In summary, the *1988 Washington Wetlands Study Report* of the Governors Executive Order Wetlands Committee found that: "the current matrix of federal, state, and local laws and regulations, when taken together, do not provide adequate statewide protection for wetlands in Washington, even though the Puget Sound Water Quality Management Plan will offer a high degree of protection in the 12 counties included in the Puget Sound region." The principle gaps in statewide coverage include:

* jurisdiction over isolated wetlands -- that is, wetlands not associated with Shorelines of the State or within the Mean High Water Mark of streams, lakes, and other waters of the state;

* regulation of agricultural and forest practices that encroach upon or convert wetlands;

* allowable activities under local Shoreline Master Programs which result in adverse activities in wetlands; and

* regulation of activities in wetlands other than filling.

Criteria 3: Existing Control Programs. Rating = 2
Similarly to Criteria 2, the selection of a rating of 2 regarding existing control programs is the result of "averaging" a number of considerations.

Certain control programs, such as Wetlands Watch or Adopt-A-Stream projects have moved beyond initial implementation and warrant a rating of 3. However, many programs -- new and established -- are operating with funding estimated to be less than 10% of that needed, thus a rating of 2 seems more appropriate.

Criteria 4: Risk Reduction Technique Availability. Rating = 4
Techniques exist to prevent the loss or degradation of wetlands; what is lacking is the express legal authority and funding to carry out many of the techniques. Some techniques are untried or little used in Washington state, thus some experimentation and adaptation to local conditions is likely necessary.

Criteria 5: Risk Reduction Technique Effectiveness. Rating = 3
Many of the control techniques available have been tested and found to be effective (rating = 5). The one exception is mitigation for loss or degradation; wetland managers report that in this regard our effectiveness is slight (rating = 1 or 2). Fully funded, the entire spectrum of regulatory, education, and incentive programs is therefore judged to be adequate to address a substantial portion of the problem.

Criteria 6: Annual Costs to Implement Risk Reduction. Rating = 4
The annual cost of preventing further wetlands loss and degradation appears to be in the range of $1 to 5 million, thus a rating of 4 was selected.

One simple approach to calculating annual cost is in the context of purchase. There are approximately 400,000 acres of wetlands remaining in Washington state. Assuming an average value of $1,500 per acre, it would cost $600 million to purchase all these remaining wetlands in fee. Of course, not all wetlands are "worth" $1,500 per acre -- the purchase price range for recent wetlands acquisitions in a Puget Sound delta has been $1,000 to $2,200 per acre. Alternatively, a less than fee purchase, for less than fee value, is possible, e.g. conservation easements. Additionally, any acquisition program would be carried out over time.

If wetlands were purchased in fee at, say, the annual rate of loss, approximately 800 acres, the annual cost would be $1,200,000. Operations and maintenance costs would be additional, and highly variable.

There are, of course, a number of options other than purchase which will be pursued by the Department of Ecology. Purchase is used here only as an example to derive a representative annual cost.

Criteria 7: Overall Controllability. Rating = 2
A Low to Moderate Overall Risk Controllability rating of 2 is selected based on the judgement that although the ability to control the problem partially exists, full legal authority and funding has not yet been made available.

The availability and effectiveness of control techniques (Criteria 4 and 5) were rated 4 and 3 respectively, thus it is clear that in part we have the "technological" ability to address the problem. The public -- at least a vocal segment -- is aware of the problem (rating of 5 for Criteria 1) and has been acting on their knowledge. However, an existing legal authority (Criteria 2) to address the problem is lacking, and thus was rated 2. A corollary of a lack of legal authority is a lack of funding to carry out existing control programs (Criteria 3) which was therefore also rated 2.

Washington Environment 2010
Action Strategy Analysis Committee
Controllability Rating

Threat: Nonchemical Impacts on Forest Lands
Risks: Ecological and Economic Damage

This evaluation addresses four major threats to forest lands:
1) Conversion of Commercial Forest Lands to Non-Forest Uses;
2) Conversion of Old Growth to Second Growth Forests;
3) Recreational Uses of Forest Land; and 4) Silviculture.

Control Options

Conversion of Commercial Forest Lands to Non-Forest Uses
-- Document types of conversion, locations, and time frame
-- Identify critical areas for groundwater recharge, sewage disposal suitability, potential for ground and surface water pollution
-- Direct growth based upon above defined critical areas
-- Zoning should be based upon existing soils and geology information
-- Strengthen forest land zoning designations
-- Improve large lot subdivision standards to reduce commercial forest land loss
-- Limit number of recreational users

Conversion of Old Growth to Second Growth Forests
-- Inventory old growth locations and characteristics
-- Establish how much, what kind, and critical locations
-- Work with major private and federal holders of old growth to preserve and convert to state ownership for preservation

Recreational Uses of Forest Land
-- Match uses with land capability
-- Land managers and users develop area-specific multiple use plans

Silviculture
Forest Road Construction, Maintenance, and Use
-- Strengthen enforcement of existing laws
-- Limit the amount of constructed roads
-- Avoid concentrations of uses (i.e. road building and harvesting)
-- Encourage more regional block plans through Timber / Fish / Wildlife (TFW)
Timber Harvest
-- Leave more branches on site, depending on nutrient status of soil
-- Reduce burning to high slash concentrations only
-- Chip slash near roads
-- Review options for control by least environmental impact

-- Determine varied slash control need throughout each unit

Reforestation

-- Only burn or scarify where absolutely necessary
-- Allow for more natural regeneration from adjacent stands
-- Allow for uneven age within units
-- Public education on fire prevention

Controllability

I. Evidence of Public Awareness or Interest in Risks Posed by the Threat Rating = 5

Conversion of Commercial Forest Lands to Non-Forest Uses
The significantly large demand upon the land base for non-forest uses is generally seen as beneficial by increasing land values. Resulting impacts are seen primarily in terms of the increased demand for services and infrastructure.

Conversion of Old Growth to Second Growth Forests
Environmental groups have sued the U.S. Forest Service over inadequacy of Forest Plans in addressing volume and types of stands to be preserved.

Recreational Uses of Forest Land
Individual groups are involved but efforts are not coordinated.

Silviculture
Timber, Fish, and Wildlife Agreement; the Forest Practices Act; and the Old Growth Commission are examples of activities reflecting public awareness of the issues.

II. Existing Legal Authority
Rating = 2

Conversion of Commercial Forest Lands to Non-Forest Uses
Cumulative impacts have not been considered to date.

Conversion of Old Growth to Second Growth Forests
The unaddressed issue is how much area and what characteristics are to be preserved and where.

Recreational Uses of Forest Land
Cumulative impacts have not been considered to date. Numbers of persons using National Parks and wilderness areas is regulated to reduce the potential for negative impacts to potentially sensitive areas. Regulation on state lands is accomplished by designating trails by type of use.

Silviculture
Recent changes in the Forest Practices Act have not been in effect and monitored for a sufficient period of time to assure adequacy. The Timber/Fish/Wildlife agreement made significant advances in the regulation of the impacts of timber harvest on other resources by all regulatory

agencies and landowners. The agreement provided a framework, procedures, and requirements for managing our state's forests so as to meet the needs of a viable timber industry and at the same time provide protection for our public resources.

III. Existing Control Programs and Adequacy to Address Identified Risk Rating = 2

National Forest Service Multiple Use Plans may address and regulate the four threats identified in this paper. The degree of control can be very site-specific.

Conversion of Commercial Forest Lands to Non-Forest Uses
No regional or statewide control program exists on private forest lands. Zoning and subdivision regulations are methods which have been used in certain communities for controlling conversion.

Conversion of Old Growth to Second Growth Forests
No regional or statewide control program exists on private forest lands.

Recreational Uses of Forest Land
No regional or statewide control program exists on private forest lands.

Silviculture
Recent changes in policy and regulation, as a result of the Timber/Fish/Wildlife Agreement (TFW), have not been in effect and monitored for a sufficient period of time to assure effectiveness.

IV. Availability of Risk Reduction Technology
Rating = 4

Conversion of Commercial Forest Lands to Non-Forest Uses
Land use controls are the primary mechanism for risk reduction.

Conversion of Old Growth to Second Growth Forests
Not enough is known of how to retain diversity in species, structure, and function.

Recreational Uses of Forest Land
Control availability and use of areas.

Silviculture
Harvesting, road building, and reforestation methods can be conducted in response to variations of site conditions.

V. Effectiveness of Risk Reduction Technologies
Rating = 4

Conversion of Commercial Forest Lands to Non-Forest Uses
Assuming that the primary risk reduction method is land use control, to the extent that it is applied lands will not be converted as rapidly to non-forest uses.

Conversion of Old Growth to Second Growth Forests
Little documentation is available on maintaining old growth characteristics. Additional information needs to be collected to determine management practices which will retain the desirable characteristics of old growth stands.

Recreational Uses of Forest Land
Limiting availability and use is very effective against the problems of increased sedimentation, soil compaction, and overcrowding.

Silviculture
Harvesting, road building, and reforestation methods can be conducted in response to variations of site conditions.

VI. Costs to Responsible Persons of Implementing Risk Reduction Technologies Rating = 2

Conversion of Commercial Forest Lands to Non-Forest Uses
Since forest lands often sell for more when being converted, the cost of restraining conversion could be seen as high.

Conversion of Old Growth to Second Growth Forests
Late successional stage of forest land experience a net loss in growth, which could be estimated as lost resource per acre per year.
Sustainability of mills set up to cut old growth could be considered an economic impact.

Recreational Uses of Forest Land
The primary costs are related to planning and managing availability.

Silviculture
The cost of alternate harvesting, road building, and reforestation methods and the evaluation of appropriate methods could be considered an economic impact.

VII. Overall Controllability of the Identified Risks
Rating = 2

Conversion of Commercial Forest Lands to Non-Forest Uses
The technology through zoning and subdivision control is available. The ability to influence dispersed decision making on land use is limited. Once forest land is converted to roads, housing developments, and industrial sites, the ecological effects are irreversible or very

long-lasting.

Conversion of Old Growth to Second Growth Forests

The impacts of conversion include a reduction in the amount of area, and species diversity, as well as a loss of ecosystem structure and function and the fragmentation of habitat. The complexity of these impacts make control or reduction of impacts very difficult. Species and structural diversity are generally not reversible in old growth stands defined in ecological terms of age, size, and structure. The silvicultural practice of timber harvesting results in a conversion of old growth to second growth.

Recreational Uses of Forest Land

Access to forest land can be controlled to some extent. Impacted areas can be rehabilitated over a long period of time.

Silviculture

In general, the process of taking land out of commercial forest production is an irreversible process. In road construction, maintenance, and use, erosion from roads will return to background levels after the roads are no longer used. Proper road abandonment procedures need to be used before background levels of sediment production can be achieved.

In timber harvesting, changes in species diversity and chemical properties as a result of harvesting old growth are not reversible.

In reforestation, the reduction of genetic and species diversity can be offset by combining planting with natural regeneration or by planting several species adapted to a specific site.

Washington Environment 2010
Action Strategies Analysis Committee
Controllability Rating

Threat: To Recreation Lands Risk: Environmental, Economic Damages

Control Options

Funding oriented options include:

- Create more recreation facilities in semiprimitive areas.
- "Land bank" future recreation development areas in the path of urban development.
- Accelerate corridor acquisition and development programs ("Rails to Trails", utility rights of ways agreements, etc.).

Statutory oriented options include:

- Transfer DNR trust lands to State Parks via compensation to the trust.
- Make greater public use of private lands (update state landowner liability law).
- Require developers to set-aside public open space areas as a part of developments.

Management oriented options include:

- Institute land use reservation permit systems, especially in primitive areas.
- Exclude private motor vehicles from park areas.
- Increase durability of visitor facilities through measures such as paving.
- Encourage balanced multiple-use, zoning.
- Private property land exchange with parks (Spokane trail).
- Transferable development rights allows trading density for open space (ie. Island County).
- Develop public-private partnerships to encourage recreational opportunities on multiple use lands.
- Identify/inventory, prioritize potential recreation lands.

Criteria #1: Evidence of public awareness and concern regarding threats to public recreation land. Rating = 4

This relatively high rating is merited due to the numerous established citizens groups which have been active in presenting formal testimony on behalf of recreational land threats. In addition, legislative interest has frequently been demonstrated.

In the mid-1980s, extensive public support was generated on behalf of increasing the size of designated Wilderness in Washington State. While this end was achieved, a significant body of opinion still holds that insufficient Wilderness ("primitive") acreage exists. Further, it is widely believed that the current spotted owl controversy exists, in part, due to the need to set aside more wildlands, which could in turn also be used for primitive recreation purposes. As a response to such efforts, other groups representing pro-commodity and development interests have appeared.

Criteria #2: Existing legal authority. Rating = 2

While numerous codes designed to alleviate threats to recreation lands exist (State Trails, RCW 67.32; Trails and Paths, RCW 47.30; Metro Park Districts, RCW 35.61; Off-Road and Nonhighway Vehicles, RCW 67.32; Aquatic Lands, RCW 79.90; Natural Areas, RCW 79.70; Land & Water Conservation Fund Act; etc.) most are currently inadequate to control relevant risks. For example, the State Trails Act does little more than establish programmatic guidelines for the recognition of high quality trails; most of the remaining statutes have provided funding, but at less than adequate levels.

Criteria #3: Existing control programs and adequacy to address identified risks. Rating = 2

It is estimated that programs designed to mitigate recreational land threats, such as over-use and intrusive road system installation, are operating with less than 10 percent of the needed resources. Generally, such programs fall into three categories:

* Funding/grant-in-aid programs (for example, for critical land acquisition and facility developments),
* Statutory measures (for example, to address the need for public land "set-asides" by private developers), and
* Management programs (for example, land transfers or hardening of sites impacted by over-use).

Criteria #4: Availability of risk reduction management techniques. Rating = 3

The risk reduction management techniques situation is very mixed. In some areas, acceptable techniques designed to manage the threat do not exist (for example, how can the need to maintain road-free semi-primitive areas be made compatible with society's need for timber resources and jobs?). Some techniques are still fairly new in Washington, and have not been widely implemented (for example, backcountry reservation systems to alleviate over-use). In other areas, proven techniques are available, but only address a small part of the threat (for example, funding of land banking programs).

Criteria #5: Effectiveness of risk reduction management techniques. Rating = 4

If fully implemented, identified risk reduction techniques have a realistic potential of addressing a majority of the identified threats. Perhaps the key to realizing this effectiveness, however, is the implementation of land acquisition programs adequate to stay ahead of the over-use problem. In the IAC's 1989 "Needs of Public Outdoor Recreation Agencies" (a broad spectrum survey of 147 of Washington's recreation land managers), a majority of respondents said that over-use issues constitute the biggest threat facing their discipline today.

Criteria #6: Costs to entities responsible for implementing risk reduction management techniques. Rating = 2

One of the main ways of reducing land over-use problems is to improve the recreational infrastructure. Years of insufficient financial support for outdoor recreation has caused critical fiscal needs.

According to the IAC's 1989 survey of "Needs of Public Outdoor Recreation Agencies", based on six year projections, no public agency (municipal, county, special district, state, federal) expects more than 50 percent of its acquisition, development, or renovation needs to be met. Municipal and county agencies will require $129 million per year to fulfill mandates and serve their clientele. Unfortunately, these agencies anticipate that only $57 million will be expended. The resultant annual shortfall of $72 million is only a part of the problem, however.

The unmet needs of special park districts, tribes, state and federal recreation agencies are also critical and will require additional funding. State agencies expect less than 25 percent of their land acquisition needs to be met; federal agencies expect less than 25 percent of their development needs to be met.

What would the money buy? Municipalities universally express a need for playgrounds, ballfields, courts, pools, bicycle and pedestrian paths, etc. Additionally, many facilities have outlived their expected lifespans and infrastructure renovation is sorely needed. County agencies have expressed the need for more rural opportunities, such as greenbelts, open space, trail right-of-ways, and waterfront.

An Indian tribe has reported the need to develop and renovate areas for playground activities, field and court games, trails, fishing, and boating facilities. State and federal agencies express a need to do something about the increasing number of days their facilities are full to capacity. The addition of more regional facilities, such as campgrounds and boating facilities, day use and interpretive sites and major infrastructure work is needed. Also expressed is the need to consolidate boundaries where dispersed ownership patterns exist, obtain trail rights-of-way across private property to allow access to public lands, and create facilities for nature appreciation.

Criteria #7: Overall controllability of the identified risks.
Rating = 2

Primitive lands

Congressionally designated Wilderness areas (primitive lands) have a high overall risk controllability rating (5 of 5). This is primarily due to such areas' remote location and limited access. High mountainous terrain is generally only accessible to individuals with the physical skills and equipment needed to hike into these areas during a few snow free months each year.

Urban/rural lands

The controllability of threats to Urban and Rural lands is rated at moderate (3 of 5), due primarily to the great expense associated with reducing over-use impacts. Although the current funding picture

is not bright, efforts are underway to bring about change. The American Heritage Trust bill (HR 876 and SB 370), which supports a $1 billion trust fund for parks, is now working its way through Congress. In addition, there has been some movement among concerned citizens regarding developing a similar Washington State measure.

Semi-primitive lands

Threats to Semi-Primitive lands will be difficult to repress, and so are given a low control rating (2 of 5). While current location (generally high elevation, limited use season, few access points) precludes some threats, such areas have too few facilities to support the diverse recreational pressures which impact them.

In addition, and perhaps posing a far greater threat to these lands, is the potential for the introduction of resource extraction operations. Much of the acreage currently identified as Roadless will be scheduled for timber harvest. Thus, the Roadless designation is, at best, a temporary administrative category.

Roaded lands

Threats to Roaded lands have a low overall risk controllability (1 of 5). Such lands are open to resource extraction which is heavily dependent on road systems. The smaller roads that lead to harvest areas are often abandoned until the next harvest, 40-60 years later. But the main roads remain, and land that was Semi-Primitive converts to Roaded. Due to a need for the commodities and jobs which depend on these areas, control measures are difficult.

Supplemental Material: Cost of Recreational Land Impacts

The economic impact of neglecting our state's recreational resources is tremendous. Park and recreation facilities/programs can be effective measures in mitigating the cumulative costs associated with hospitalization, absenteeism, crime prevention, incarceration, and law administration. For example, taxpayers will spend over one million dollars for each prisoner they incarcerate over a 30 year period.

Further, research has shown that those who exercise regularly pay about half of what non-exercisers spend on medical bills. One prominant company estimates that it saves $2 for every dollar it spends on recreation, employee services, and lifestyle programs.

Property values ebb and flow with a site's proximity to greenbelts, parks and open spaces. Specific studies show significant declines when such areas are located away from residences ($4.20 for each additional foot a house is located away from a greenbelt, according to one typical study - Land Economics, May 1978).

This is a particularly important point, since our larger cities often expand into areas not served by park sites. This is unfortunate, as other infrastructure needs (roads, utilities, sewers, etc.) are usually addressed through municipal code requirements.

Often, our state's wildlands are worth more for their pristine values than for their commodities. For example, the Alpine Lakes Management Act condemned 24,400 acres of land owned by the Pack River Company for inclusion into the Alpine Lakes Wilderness. The Act required purchase in fee simple by the Forest Service. Based on the land's timber, the Service valued the property at $13.5 million. An out-of-court settlement, however, placed the real value at $25 million, based on wilderness significance and scenic beauty.

The U.S. Travel Data Center estimates that travel and tourism in America directly generated 5.5 million jobs in 1988. In that same year, the travel industry was responsible for more than eleven percent of all the additional jobs created in the entire U.S. economy. Outdoor recreation and use of our recreational lands accounts for a large portion of this tourism. Neglecting these lands can have a tremendous impact on the economy.

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Controllability Rating

Threat: Nonchemical Impacts on Rangelands
Risk: Ecological and Economic Damage

Loss and/or degradation of rangelands eliminates/destroys the long term benefits of grazing. It reduces availability of hunting, fishing, and other outdoor recreational activities. It creates a susceptibility to noxious weed infestation. It creates susceptibility to wind erosion. It creates susceptibility to water erosion and reduces water quality.

Some causes are: overgrazing, ORV use, drought, fire, timber harvest techniques, vehicle spread of noxious weed, and the conversion of grazing lands to agricultural or residential uses.

Control Options

-- Increase control research
-- Reduce incidence of noxious weed transport
-- Reduce excessive grazing pressure
-- Restrict vehicle and recreational use where detrimental
-- Improve wildfire control
-- Increase education to ranchers about hazards of overgrazing
-- Supplement vegetative cover in erosion-prone areas
-- Educate:
  - public about importance of rangelands and methods to control loss and degradation
  - public on importance of noxious weed control and how to prevent spread of noxious weeds
  - ranchers about importance of riparian zone management
-- Technical Support and assistance:
  - Land managers increase support to county weed board programs
  - Take active role in Coordinated Resource Management Plans (CRMP)
  - Hire technical staff and utilize existing technical staff to identify lands which have been overgrazed
  - Use technical staff to educate users and public
  - Use technical staff to participate in CRMP, weed boards, other federal/state/local government programs
-- Government and private landlords to review grazing and leasing practices and reduce grazing pressure, where detrimental
-- Strengthen county zoning to restrict the conversion of rangelands

Controllability

I. Evidence of Public Awareness or Interest in Risks Posed by the Threat — Rating = 2

Generally, the public awareness is low. In the past few years, the public has become more aware of the dangers associated with degradation of rangelands. Public agencies and private associations exist to inform, educate, and encourage ranchers and land managers to conserve range resources. A consortium of such interest is the Washington State Rangeland Committee.

II. Existing Legal Authority — Rating = 4

Counties have the legal authority to form weed boards and levy weed assessments on all land owners in the county.

Government agencies with management responsibility have the authority to control numbers of animals grazing public lands. The Rangeland Protection Act enables the National Forest Service and Bureau of Land Management to better manage rangelands.

The State has the authority to restrict ORV use, restrict campfires, close land to trespass, and require resource protecting agreements be entered into and complied with by its lessees.

III. Existing Control Programs and Adequacy to Address Identified Risk — Rating = 2

Considering the vastness of the lands involved and the diversity in ownership, it is very difficult to implement programs to address the problem and especially difficult to enforce the programs. In most cases, it involves cooperative efforts on the part of private and governmental owners. A good example of this is the Coordinated Resource Management Plans (CRMP) efforts of private, state, and federal entities to identify problem areas and to enact management plans to coordinate joint efforts to correct the problem.

Cooperative extension funds are available to identify problem areas and to research potential solutions. County weed boards acquire funding through mandatory assessments. These are in place and functioning, but agencies are not able to implement programs at a scale necessary to alleviate the problems.

IV. Availability of Risk Reduction Technology Rating = 4

The technology and management techniques do exist to eradicate the rangeland degradation. Education programs need to be intensified to inform land managers of economically feasible technologies.

V. Effectiveness of Risk Reduction Technologies Rating = 5

If all available technologies were fully implemented the identified risks could be significantly reduced.

VI. Costs to Responsible Persons of Implementing Risk Reduction Technologies Rating = 3

Start-up costs to implement risk reduction technologies are not extremely high. But, depending on the technology used and the economies of scale, cost/benefit considerations could preclude implementation. Research to identify and build effective programs is a major cost. It is assumed that upon implementation of certain technologies, landlords will suffer short-term loss of potential income through reduced grazing rental income and ranchers will suffer short term losses of potential income by limiting herd size and increased costs of moving their livestock between ranges.

VII. Overall Controllability of the Identified Risks Rating = 3

Rangelands can be protected and improved. The technology exists. The largest obstacles to overcome are: increasing public awareness, obtaining funds, creating a cooperative framework in which all landowners can communicate effectively within, enforcement of policies necessary to achieve program goals, and providing cost effective methods for small owner, ranchers, and counties to participate.

Washington Environment 2010
Action Strategies Analysis Committee

Controllability Rating

Threat: Nonchemical Impacts on Agricultural Land
Risk: Ecological and/or Economic Damages on Agricultural Land

For the purposes of this report, the nonchemical impacts for which controllability will be analyzed include soil erosion and conversion to other uses.

Soil Erosion

The types of erosion included in the risk analysis include, wind, sheet, and rill.

Control Options

Government Programs:
-- Increased participation in soil conservation programs. Some of the most productive non-irrigated farmland in the state is also highly erodible. A prime example of this phenomenon is Southeastern Washington. Factors which could contribute to meeting this goal include:
- Increased technical support and assistance to agricultural producers in critical areas.
- Both increased incentives to participate as well as making participation a prerequisite for receiving any other Federal benefits.

-- Control options vary by crop type but usually include proper crop rotation, no-till or minimum-till programs, strip cropping, proper irrigation, etc.

Conversion to Other Uses

Conversion of agricultural land to other uses is mainly a threat in those areas within or in proximity to concentrations of population. The control options will concentrate on all forms of conversion.

Control Options

-- Economics is the primary driver behind conversion of farmland to other uses. Keeping farmland more economically viable than conversion to other uses is seen to be a desirable goal.
-- If economics are not conducive for keeping agricultural lands, then other options should be pursued such as local land use planning which recognizes the quality of life aspects of retaining a base of agricultural land.
-- Statewide land use planning would be the most extreme option.

Controllability

I. Evidence of public awareness or interest in risks posed by the threat.

With respect to erosion, the public is awareness is generally moderate. There has been no real outcry from the public for better conservation measures. With respect to conversion of agricultural land to other uses, there is increased awareness especially in urbanized areas and farmland preservation programs are either being implemented or discussed.
Rating: 3

II. Existing legal authority.

With respect to erosion, the Federal government has the authority to withhold farm program payments if certain conservation requirements are not met. Other government entities at the state and local level simply are in the assistance business. As for conversion, local government has the authority to enforce planning ordinances which has some effect on when and how development occurs. However, as was stated previously, economics plays a large part in the scenario.
Rating: 3

III. Existing control programs and adequacy to address identified risk.

With respect to erosion, existing control programs, if fully implemented and funded are adequate. Research is being done, however, which may someday become part of control programs. Existing control programs are not adequate to address the problem of conversion. Economics is still, largely, the controlling factor. Because erosion is the greater risk, it will be given greater weight in this evaluation.
Rating: 4

IV. Availability of risk reduction technology.

Although research is ongoing, the technology along with the appropriate management techniques are available for controlling erosion. Conversion of farmland to other uses is an economic problem and has little to with technology. However, there are a variety of management strategies available which have been discussed earlier.
Rating: 4

V. Effectiveness of risk reduction technologies.

The available technology is effective in controlling erosion. If you expand definition of "technologies" to include management strategies, their effectiveness depends on economics and political will.
Rating: 3.5

VI. Costs to responsible persons of implementing risk reduction technologies.

There is a wide range of control strategies for soil erosion. Most options which are available entail some additional expense to the producer. However there are cost-share opportunities if the conservation plan is approved by the appropriate governmental entity. The costs of preventing conversion are usually measured in economic costs and are dependent upon the viability and profitability of the agricultural land under consideration. For both of these threats the author was unable to locate an estimate of what it would cost to implement appropriate risk reduction strategies in all areas.
Rating: 3

VII. Overall controllability of the identified risks.

Agricultural lands can be protected from erosion and improved. Depending on economics and public sentiment, conversion can be prevented as well.
Rating: 3.5

WASHINGTON ENVIRONMENTAL 2010
ACTION STRATEGIES ANALYSIS COMMITTEE
CONTROLLABILITY RATING

THREAT: PESTICIDE DRIFT RISK: HUMAN HEALTH

Pesticides are widely used in the state of Washington and this use is increasing. While such use is targeted for specific purposes and areas, the available methods of application, particularly aerial application, cause nontarget areas to be exposed to pesticides through pesticide drift. While the state's agricultural and forest economies depend on pesticides for crop protection and vegetative management, pesticide use is not only a rural concern. The widespread use of pesticides by homeowners and garden care operators make the threat of pesticide drift a problem for urban dwellers as well. When pesticide drift occurs, the public can potentially be exposed to pesticides through several direct and indirect pathways in the environment.

The problem of pesticide drift must be recognized as a real problem, with a definite potential for impact on human health. While no quantitative risk assessment can be made regarding pesticide drift, there is evidence that, given the right dose, certain pesticides can cause a wide range of health effects. Unfortunately the extent and nature of the health effects in Washington remain unknown until better documentation can be made regarding the pesticides actually drifting and the exposures individuals are actually receiving from drift.

CONTROL OPTIONS:

Even though specific risk cannot be determined, it seems prudent to limit the exposures of the population to pesticide drift whenever possible. A number of different strategies could be used to reduce and/or mitigate drift problems. In the following list the basic strategy is indicated first, with examples specific to controlling pesticide drift listed below the strategy. The control options given are only a sample of several different ways to reduce pesticide drift. Some are obviously more practical, reasonable or appropriate than others, but all could conceivably reduce the presumed potential health impact associated with pesticide drift.

- PREVENT CREATION OF THE PESTICIDE (DRIFT) IN THE FIRST PLACE, e.g:

  Develop new strains and varieties of crops that are more resistant to pests so that pesticides would not be needed.

  Develop and use a wider variety of non-chemical methods for pest control, including natural hosts and biological methods.

  Support land development that eliminates agricultural uses in favor of uses where pesticides or other chemicals are not likely to be used.

- REDUCE THE AMOUNT OF PESTICIDE (DRIFT), e.g:

  Reduce the amount of pesticide applied and/or further dilute the concentration allowed for certain applications, particularly those done by homeowners.

  Restrict application methods used with certain pesticides having known health impacts to techniques having less likelihood of drift problems.

  Reduce the pesticide drift by using spray adjuvants designed to reduce volatility or enlarge droplet sizes etc.

  Increase the cost of pesticide use (e.g. tax pesticide use, increase permit costs, etc.).

- PREVENT THE RELEASE OF PESTICIDES THAT ALREADY EXIST, e.g:

  Eliminate application methods likely to cause drift in all or certain areas.

  Change cultural practices and expectations regarding what is "good" produce in the supermarket. (e.g. Organically grown produce is more expensive and generally doesn't look as good as the other produce, but there are few pesticides used in its production.)

- MODIFY THE RATE OR SPATIAL DISTRIBUTION OF RELEASE OF THE PESTICIDE, e.g:

  Restrict pesticide applications to certain microclimatic and climatic conditions.

- SEPARATE, IN TIME OR SPACE, THE PESTICIDE DRIFT AND THAT WHICH IS TO BE PROTECTED, e.g:

  Provide advance notification of proposed pesticide applications so that community members can avoid the general area.

  Provide buffer zones between areas of aerial application and sensitive crops or the public.

- SEPARATE THE PESTICIDE DRIFT AND THAT WHICH IS TO BE PROTECTED BY INTERPOSITION OF A MATERIAL BARRIER, e.g:

  For ground applications, a barrier of tall trees or fencing may block drift to adjacent properties.

  The provision of markers on and adjacent to fields to be sprayed can indicate sensitive ecological areas and water sources which must be avoided during applications.

- MODIFY RELEVANT BASIC QUALITIES OF THE PESTICIDE APPLICATION, e.g:

  Improvements could be made in equipment, particularly that used for urban application (e.g. wind blast sprayers) so that the likelihood of drift is reduced.

  Modifications could be made to the spray nozzles on pesticide application equipment (i.e. change nozzle size, configuration, etc.) so that drift is reduced.

  The speed and timing of the applications could be modified to reduce drift.

- MAKE WHAT IS TO BE PROTECTED MORE RESISTANT TO DAMAGE FROM THE PESTICIDE, e.g:

  Protective clothing (e.g. long-sleeved shirts vs. T-shirts) could be worn by residents suspecting pesticide drift on their property.

  Encourage the public to develop good health habits in general to reduce their personal risks (for example, potential synergistic effects associated with smoking etc.).

  Increase the level and quality of information available to the public about pesticide use, application, and potential impacts.

- BEGIN TO COUNTER THE DAMAGE ALREADY DONE BY THE PESTICIDE DRIFT, e.g:

  Provide a readily available system by which possible pesticide drift can be immediately reported, investigated and documented.

- STABILIZE, REPAIR, AND REHABILITATE ANY OBJECT OF THE DAMAGE, e.g:

  Educate physicians regarding the symptoms and responses to potential pesticide poisonings or dermal reactions.

  Educate the public regarding appropriate responses to a possible pesticide incident.

CONTROLLABILITY CRITERIA AND RATING VALUES:

Criteria #1: Public Awareness of Risk Rating = 5

The public is very aware of the problem of pesticide drift, particularly in agricultural areas. There are lawsuits pending in the Tri-City area regarding pesticide drift, including civil litigations between parties as well as a lawsuit against the WSDA.

Washington Environment 2010
Action Strategies Analysis Committee

Controllability Rating

Threat: **Pesticide Residues In and On Food**
Risk: **Human Health**

Pesticides are widely used in food production nationwide, including Washington. Not every food crop is treated with pesticides and most treatments are made in response to an identified presence of a pest. The main source of pesticides in food is the application of pesticides to the crop or to the land prior to planting the crop. An elaborate regulatory framework intended to protect consumers from unacceptably high levels of pesticide residues in foods is in place, including pesticide registration and pesticide tolerance levels.

Control Options

- -- Increase information gathering efforts to determine which pesticides in what amounts are used in food production in Washington
- -- Increase sampling and analysis of food crops for detecting residues
- -- Increase production of foods using organic methods or other methods that minimize use of pesticides (such as those promoted under USDA's low input sustainable agriculture program)
- -- Increase research efforts to produce narrow spectrum pesticides with short half-lives
- -- Develop crop varieties that are resistant to pests and disease
- -- Wash or peel food as appropriate prior to consumption
- -- Educate the public about current food production methods including the use of pesticides and their registration process
- -- Educate crop producers about minimizing the use of pesticides or using alternative, less toxic methods for pest control in food production

Controllability

I. Evidence of Public Awareness or Interest in Risks Posed by the Threat — Rating = 4

Generally, the public awareness and concern of the human health risk associated with pesticide residues in food is high. Recent media coverage of incidents of detected residues of Alar (a growth regulator used in apples) has heightened the level of public concern about safety of the food supply. The Natural Resources Defense Council (NRDC) published information on Alar residues in apples, which was aired on "60 Minutes," a nationally televised program. Subsequently, a well-known actress joined in

the movement to increase public awareness of pesticide residues in food. Newspapers, magazines, and other forms of media followed with extensive coverage of the issue. The accuracy of the information outlined in the NRDC report has been criticized by the scientific community, and while the public's awareness on the food safety issue has been heightened, it has been based upon questionable data.

II. Existing Legal Authority — Rating = 5

Both state and federal governments have clear authority to monitor and regulate pesticide residues in food. On the state level, the Washington State Department of Agriculture regulates pesticide residues through the Uniform Washington Food, Drug and Cosmetic Act, and the federal Food and Drug Administration regulates residues through the Food, Drug and Cosmetic Act. Judicial case law has supported this authority on the federal level and in other states.

III. Existing Control Programs and Adequacy to Address Identified Risks — Rating = 4

Food sampling and analysis programs for pesticide residues on both the state and federal levels have been operating for years. These programs are fully matured and specifically address the threat of detecting pesticide residues in foods. With the increased public concern regarding food safety, additional responsibilities have been identified to enhance the already operational programs. Increased levels of sampling foods as well as increased sensitivity in laboratory analyses have been suggested to augment existing efforts. Current resources at the state level are inadequate to meet these demands.

IV. Availability of Risk Reduction Technology — Rating = 4

The technology and management techniques do exist to reduce the level of pest residues in food. This primarily involves decreased use of pesticides or substitution of products with short half-lives and increased specificity (without decreased efficacy) in food production. Research programs are in place to develop pest resistant crop varieties and newer, more specific pesticides. Public and producer education is addressed through the media and through Cooperative Extension programs. Monitoring of food residues has recently been enhanced through development of more sensitive laboratory analytical methods as well as increased sampling frequency of some commodities.

V. Effectiveness of Risk Reduction Technologies — Rating = 5

If all available technologies were fully implemented, the amount of pesticide residue on food would be significantly reduced.

VI. Costs to Responsible Persons of Implementing Risk Reduction Technologies — Rating = 3

The annual average estimated cost of implementing risk reduction technologies is between $5 and $50 million. Research and development costs for new, more specific pesticides are very high. Additional costs of testing and registration add much to the already large R & D figure. Reduction in the use of existing pesticides in food production would reduce yields and potentially increase food costs to the general public. Costs incurred for increased sampling and analysis of food products for pesticide residues would be substantial. Education of producers and consumers could be a major expense.

VII. Overall Controllability of the Identified Risks Rating = 4

Pesticide residues in food can be reduced in both quantity of food with residues and level of residues detected. The technology has been identified and exists. The largest obstacles to overcome are the enormous costs associated with development of new pesticides or pest resistant crops, or, alternatively, the reduced yields that would result if current pesticide usage were curtailed or banned. Implementing many of the identified technologies is dependent upon the willingness of the individual to change food preparation methods or production methods, which is difficult, at best, to control or modify.

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Controllability Rating

Threat: Household Uses of Pesticides
Risk: Human Health

The principal exposure of the general population of the United States to pesticides occurs in and around the home. Over 90 percent of all U.S. households use pesticides, including insecticides, disinfectants (antimicrobials), fungicides, and herbicides. Residents may be exposed to pesticides through inhalation, dermal absorption, and ingestion.

Control Options:

-- Increase natural ventilation, such as opening windows
-- Mechanical ventilation with room fans or forced air
-- Discontinue use of pesticides indoors, including disinfectants
-- Educate consumers on proper and appropriate uses of pesticides in the home
-- Wash or peel food (when appropriate) prior to consumption
-- Wear appropriate protective gear (gloves, respirator, etc.) when applying pesticides to prevent dermal absorption
-- Hire lawn care professionals to treat yard with pesticides as needed
-- Store pesticides in original, labelled containers in a building or structure detached from the house
-- Child-proof pesticide storage areas (including disinfectants)
-- Make extremely hazardous pesticides available only to certified commercial applicators
-- When applying pesticides to home gardens, follow label instructions on application methods
-- Increase research in biological control methods appropriate for treating pests in households
-- Increase research and development of narrow-spectrum, short half-life pesticides with low toxicity to humans and other non-target species

Controllability

I. Evidence of public awareness or interest in risks posed by the threat — Rating = 3

Because of media attention to EPA's chlordane ban a few years ago, the level of public awareness is relatively high. Additionally, people are becoming more and more aware of the varied uses of pesticides, including the uses of such products in the home, through more recent media blitzes centering on

pesticide use in food production.

II. Existing legal authority — Rating = 4

State and federal laws exist which indirectly address the issue of pesticide use in the home. The registration and labelling of pesticides for specific uses, the licensing of applicators (in the case of lawn care companies and pest control operators), and prescribing methods for application are legal requirements designed to minimize the hazard of pesticide use.

III. Existing control programs and adequacy to address identified risks — Rating = 4

Control programs do exist for those pesticide uses associated with commercial applicators. These programs are adequate to generally control the risks posed by such activities as termiticide application or commercial lawn care. However, the majority of risk associated with household pesticide use is apparently due to misapplication by the homeowner. No laws exist that regulate private actions concerning pesticide application to personal property, unless such application affects other premises or individuals.

IV. Availability of risk reduction technology — Rating = 3

Research in production of safer pesticides or biological controls for use in the home is ongoing but not yet available. Education of the public regarding appropriate pesticide application through the media is a constant process, but overcoming the "more is better" tendency is difficult. Many of the technologies are simple, common sense procedures, such as appropriate use and storage of the materials, and proper ventilation during and after use.

V. Effectiveness of risk reduction technologies — Rating = 4

The effectiveness of the technology depends upon which option (or combination of options) may be selected. If all options were implemented, the risks associated with household use of pesticides would decrease markedly.

VI. Costs to responsible persons of implementing risk reduction technologies — Rating = 4

On an annual basis, the costs of implementing risk reduction technologies would be estimated to be between $1 to $5 million, which would focus on homeowner education. Research to develop new pest control techniques should be implemented with household use consideration. The expense of most identified existing technologies, such as increasing ventilation or proper storage of pesticides, would be borne by the consumer at relatively low costs, though hiring lawn services may be expensive.

VII. Overall controllability Rating = 4

With slight modifications in consumer habits, which could be brought about using appropriate education, the health risks attributed to household pesticides could be reduced. Since the public has recently become more aware of other uses of pesticides, and this awareness has apparently resulted in a desire for improved pesticide management, it follows that the public would be motivated to modify individual actions toward that end. Simple, individually controlled actions such as proper use of protective equipment when using pesticides, proper storage of the materials, and increasing ventilation after usage could be emphasized in public education efforts, and should enjoy wide acceptance.

Washington Environment 2010

Summary of Risk "Controllability" Ratings
Action Strategies Analysis Committee

23 Threats to Environmental Resources	Controllability Rating Criteria						
	Evidence of Public Awareness	Existing Legal Authority	Existing Control Programs	Availability of Technology	Effectiveness of Technology	Implementation Costs	Overall Rating
1. Ambient air pollution	5	3	3	5	4	2	3
2. Indoor air pollution	5	2	2	3	2	2	2
3. Radioactive releases	5	4	3	4	5	1	4
4. Indoor radon	4	2	2	5	5	4	4
5. Nonionizing radiation	4	4	4	5	3	2	2
6. Global warming/ ozone depletion	4	2	2	3	3	1	3
7. Point discharges to water	4	3	4	4	4	3	4
8. Nonpoint discharge to water	3	4	3	4	4	2	3
9. Drinking water contamination	5	4	4	4	5	3	4
10. Acid deposition	4	2	2	4	5	5	4
11. Hydrologic disruptions	5	3	3	3	3	2	3
12. Regulated hazardous waste sites	4	4	3	4	4	4	4
13. Uncontrolled hazardous waste sites	5	4	3	3	3	2	4
14. Nonhazardous waste sites	5	3	3	4	5	3	4
15. Materials storage	4	4	2	4	5	3	4
16. Sudden and accidental releases	4	2	3	3	3	2	3
17. Litter	4	2	2	4	4	3	3
18. Wetlands loss/ degradation	5	2	2	4	3	4	2
19. Nonchemical impacts on forest lands	5	2	2	4	4	2	2
20. Nonchemical impacts on recreation lands	4	2	2	3	4	2	2
21. Nonchemical impacts on range lands	2	4	2	4	5	3	3
22. Nonchemical impacts on agricultural lands	3	3	4	4	3.5	3	3.5
23. Pesticides (not covered elsewhere)							
Drift	5	4	3	3	4	2	3
Food residues	4	5	4	4	5	3	4
Household use	3	4	4	3	4	4	4

Very little is known about impacts to groundwater. (Rating = 3)

Criterion 6: Costs of Implementing Risk Reduction Technologies. Rating = 2

Implementation of agricultural BMP's is considered cost effective over the long term. Improved waste management can reduce commercial fertilizer costs and soil conservation assures productivity for future generations. BMP's are not widely accepted and used because of the up front costs and skepticism of long term benefits. Estimated costs for animal waste management are $40 million (800 operations @ $50,000 each), irrigation water management are $30 million (500 @ $20,000 - 100,000 each), dryland erosion control are $10 million (1,000 @ $10,000 each), rangeland management are $10 million (1,000 @ $10,000 each), non-commercial farms are $30 million (15,000 @ $2,000 each) and stream corridor management are $60 million (4,000 miles @ $15,000/mile). Total agricultural costs are in the range of $180 million through 2010.

Costs of implementation of forest practices include higher road construction and maintenance, loss of value of timber left in riparian and other leave areas, and increased operational costs. Costs are likely in the range of $50 million annually or $1 billion through 2010.

Estimated total costs through 2010 of correcting failing on-site systems (5% of 575,000 systems at $2,000 each) are $57.5 million and ongoing maintenance (pumpout every 5 years at $100 each) are $12 million. Costs of stormwater utilities are about $5 per household per month and the cost for new development is about $1,000 per new home. Stormwater is approximately $150 - $200 million per year for a total of $3.5 billion through 2010. Estimated costs for resource extraction are in the range of $5 million/year or $100 million through 2010.

Total costs for nonpoint are in the range of $4.8 billion through 2010 or an average annual cost of $240 million.

Overall Controllability. Rating = 3

Although the programs and technologies (BMP's) are well developed, implementation will continue to be slow due to the widespread nature of agricultural activities and the initial start up costs. The sheer numbers of individuals that need to become aware of the results of their activities and receive incentives and technical assistance makes controllability difficult. Up front and ongoing management costs also slow program implementation. The effectiveness of the small increase in regulatory programs is unknown. Finally, the observed impacts outlined in the risk assessment are significant and widespread. (Rating = 3)

The forest practices programs and technologies are proven and well accepted. The interested and affected parties are committed to working together to identify and control impacts from forest practices. (Rating = 5)

On-site wastewater and resource extraction are well developed programs that have a high potential to control risks. Urban stormwater and highway runoff have significant impacts and costs for control with programs to address them just getting started. (Rating = 3)