HAZARDOUS WASTE MANAGEMENT IN THE NORTHWEST:

A STATUS REPORT

Prepared for the

U.S. Environmental Protection Agency Region 10

and the States of

Alaska, Idaho, Oregon and Washington

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EXECUTIVE SUMMARY

AUGUST, 1987

Hazardous waste management data are collected and analyzed independently and in somewhat disparate fashion by the Region 10 offices of the U.S. Environmental Protection Agency and the pollution control agencies of the northwest states. Accurate and comprehensive information regarding hazardous waste generation and management will be needed soon if the industries and governmental entities of the region are to establish a coordinated planning program capable of identifying cost-effective means of compliance with new statutory mandates. One important aspect of the emerging regulatory program is the requirement that states demonstrate by 1989 that disposal capacity will be available for all hazardous wastes expected to be generated in the next 20 years. Certification to that effect will be necessary if a state is to remain eligible for remedial action funding through the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act.

An assessment of the status of hazardous waste and PCB waste control programs in Region 10 was conducted in an attempt to characterize the materials and current handling methods and to consolidate waste management data from the four states (Alaska, Idaho, Oregon, Washington). The nature and effectiveness of the data collection systems were also examined.

Hazardous Waste Generation

The most recent biennial reports (1985) and other documents were reviewed so that sources and amounts of waste regulated pursuant to the Resource Conservation and Recovery Act and companion state laws could be determined. Eight hundred eighty-two major generators produced reportable quantities of hazardous waste during 1985 (Alaska, 23; Idaho, 30; Oregon, 206; Washington, 623). Fifty-seven percent of the generators were manufacturing plants and 29% were trade, services or governmental organizations.

The Region 10 major generators reported 228,910 tons of hazardous waste, exclusive of PCBs. Washington contributed 198,464 tons (86.7%); Oregon , 26,813 tons (11.7%); Idaho, 2024 tons (0.9%); and Alaska, 1609 tons (0.7%). Small quantity generators produced an additional 11,000-12,000 tons of waste, and 30,000-60,000 tons of unregulated hazardous waste from households were sent mostly to public solid waste landfills.

Manufacturing industries accounted for 86% of the waste, the largest fraction (37.5%) coming from primary and secondary metals processors. Stone and clay products industries produced 15.3% of the waste, transportation equipment manufacturers 10.3%, and the electronics companies 4.5%. Only about two percent of the waste came from cleanup of contaminated sites in 1985 (in 1984, the figure was nearly 20%).

Almost one-half of the wastes were those regulated only by the State of Washington (104,349 tons, 46%), such as cement kiln dust, furnace black dross and potlining from the aluminum industry, boiler fly-ash from the wood products industry and fluxing salts from magnesium reduction. The dominant RCRA-regulated wastes were metals (14%), corrosives (9%), electroplating sludge (8%), steel emission dust (4%) and non-chlorinated solvents (4%).

Disposition of Hazardous Waste

The Region 10 states ship waste to one another and to facilities in other states for treatment and disposal. Waste is also imported to the region for disposal. Nearly 10,000 tons of waste were exported from the region in 1985, while 3694 tons were imported; thus, the region was a net exporter of hazardous waste. Alaska exported 10% of its waste to other Region 10 states and 40% to states outside the region. Idaho exported one-half of its waste to Oregon and Washington and 38% to states outside the region, but also imported twice as much waste for disposal as was exported. Oregon exported over one-half of its waste (15,000 tons), but imported nearly 66,000 tons for disposal, most of which came from Washington.

Region 10 wastes are often subjected to a series of reportable management processes; the reports of each management practice result in double or triple counting of some wastes, and therefore the generator and facility reports cannot be easily reconciled. Imported wastes cannot be specifically tracked either. Thus, the waste facility reports document the handling of substantially more waste than is generated in a given year.

On-site storage (for over 90 days) accounted for 107,000 tons of waste in the region in 1985 and 75,000 tons were stored off-site. The predominant storage method (by weight) was waste piles. Nearly 10,000 tons of waste received on-site treatment and 49,000 tons were treated off-site. On-site disposal of 63,000 tons of waste was accomplished, while 77,000 tons were disposed of at off-site facilities. Over 100,000 tons of Region 10 wastes were landfilled and 45,000 tons were impounded as a treatment process or final disposal; 1111 tons of waste were deep well injected in Alaska.

PCBs

Wastes containing polychlorinated biphenyls were considered separately since they are regulated by the Toxic Substances Control Act rather than as RCRA hazardous wastes. A limited special survey of electrical utilities and other waste generators provided new insight regarding PCB waste generation in Region 10. Concentrated PCB waste oils (greater than 500 ppm PCB) were apparently generated in an amount falling within the range of 450-550 tons in 1985. Mineral oil wastes with PCB concentrations from 50-500 ppm may have totaled 1200-1600 tons.

Disposal of waste transformer carcasses was estimated to amount to 2000-4000 tons. PCB-contaminted soil, debris and miscellaneous equipment constituted 2000-3000 tons of waste. The generation of high concentration PCB oil wastes in Region 10 is expected to increase slightly until 1988, remain fairly constant until 1991, and then decline precipitously due to several regulatory factors. The lesser-contaminated mineral oils, mostly present in long-lived transformers, will remain in the waste stream in slowly declining amounts for 15-30 years. PCBs are no longer being manufactured and have not been distributed in commerce for some time; however, remedial action projects, particularly in Alaska, will generate PCB wastes for 10 years or more.

Projected Hazardous Waste Generation

Several elusive factors affecting the future generation of hazardous waste in the region were crudely estimated as part of this assessment. Economic growth, waste reduction practices, PCB equipment phaseouts and implementation of remedial action (site cleanup) programs were projected to produce a small net increase in waste generation over the 1985 level during the next 20 years. The routinely generated wastes (non-cleanup) are expected to decrease somewhat in the next 15 years due to waste reduction programs, but ultimately increase from the 1985 base amount as a result of industrial growth; however, the projection of other quite different scenarios could be easily justified.

Hazardous Waste Management Technology

The Region 10 hazardous waste streams were generally analyzed in terms of the applicability of alternative technology because of the impending limited national ban on landfilling of wastes. One hundred twenty-six thousand tons of Region 10 RCRA-regulated wastes (based on 1985 data) will be considered for landfill ban by 1990 through the EPA regulatory process. Less than half of that waste is being landfilled now (other than Washington-regulated waste).

Including contaminated soils, up to 60,000 tons of hazardous waste per year might be amenable to incineration; however, two-thirds of that waste would probably require fuel-assisted burning due to low potential heat content. Wastes to be landfilled could increase or decrease depending on economic factors arising from the treatment standards (most not yet established) associated with the landfill ban statute. Increased recycling and treatment of some categories of waste are probable. However, alternatives to landfilling will not be readily available for some wastes, and the stabilization and encapsulation processes which might be applied to those wastes would substantially increase their volume prior to landfilling.

Waste Management Capacity

A review of waste management facility permit applications revealed a potential regional on-site capacity for waste storage to be nearly 280,000 tons, far more space than actually occupied in 1985. On-site treatment facilities would handle over 30,000 tons of waste per year, other than dilute aqueous wastes which can be treated in very large volumes. Proposed on-site incinerator capacity totals 4700 tons per year. Permit applications for on-site disposal reflect facilities capable of handling three trillion tons of wastewater per year by injection well (Alaska only), 57,000 tons by landfill or land application, and 34,000 tons by impoundment.

Existing and proposed off-site storage facilities would provide space for 250,000 tons of waste, mostly in piles and impoundments. Various off-site treatment facilities could handle up to 400,000 tons of aqueous inorganic wastes, solvents, toxic anions and oily wastes. No commercial incinerators exist in Region 10. One formal permit application has been filed for construction of an incinerator which would burn up to 50,000 tons of waste per year, and plans for a similar (competing ?) project have been informally announced.

Off-site landfill capacity as proposed for 10-year RCRA permits would be about five million tons. The lifetime of the Idaho commercial landfill is estimated by the company to be exactly 20 years (2007); such a rate of fill would require the annual intake of waste in volumes 4-5 times as great as in 1985.

The Oregon commercial landfill would be full in 18 years (2005) at the rate of fill experienced in 1985; in 12 years (1999) at the 1986 rate of fill; and in 9 years (1996) at the rate of fill anticipated by the company. However, note that the company owns much more land adjacent to the existing facility which could be developed as landfill. The actual permit proposals beyond the next 10 years cannot be anticipated.

Problems/Recommendations

Several problems were encountered when using the various hazardous waste management data systems. Most of those problems relate to the unfamiliarity of some generators with the reporting requirements and formats, the narrow scope of required data, unsophisticated reporting systems in some states, poor coordination of data collection processes in the region and the absence of a suitable central data repository.

It is recommended that a regional or national hazardous waste data management system be developed with the following features:

1. A single report form to be used by all states (or as the core of any state-developed form) to collect data both from hazardous waste generators and waste management facilities.

2. Surveys conducted at least annually and summary reports issued without great lag time.

3. Clearly-stated reporting requirements, particularly with regard to definitions of reportable wastes (for example, under what circumstances are volumes of wastewaters reportable prior to treatment? Conversely, when are treatment residuals reportable as newly generated wastes?)

4. An annual determination of the regulatory status of all potential generators.

5. Verification of all generator and facility-reported data by state agencies and EPA (staff augmentation required).

6. Characterization of wastes in terms of physical form and all relevant chemical components (within the limits of practical analysis) through use of a more complex coding system.

7. Tracking of wastes throughout the country and reporting of treatment and ultimate disposal of those wastes to the regulatory agency in the state of origin.

8. The capability to account for stored wastes at the beginning as well as at the end of a reporting period.

9. More detailed description of waste treatment processes through a more complex coding system.

10. The capability to compare the volumes of various wastes on an annual basis and to determine the degree to which each generic means of waste reduction is employed by each category of industry.

11. The capability to determine the remaining permitted capacity of landfills on an annual basis and the practical throughput capacity of treatment facilities.

12. The entry of all core data into a commonly accessible automated system.

It is further recommended that the Region 10 states, individually or collectively, conduct intensive studies of waste management capacity and waste reduction potential as soon as practicable. The advice and assistance of the waste generating industries and waste management businesses should be solicited to assure success of the investigations.

INTRODUCTION

The production, distribution and use of potentially hazardous chemical substances have dramatically increased in the United States during the past forty years. The demand of a growing population for products and services has resulted in the accelerated manufacture of chemicals whose properties are dangerous under certain circumstances. New synthetic organic chemicals are developed at a rate of over 1500 per year, and the total yearly volume of such materials in commerce is at least three times the amount produced annually in the early 1950's.

Our complex society has also increased the variety of routes through which humans and their environment can be exposed to this expansive array of useful but dangerous materials. A heightened awareness of the extent to which such exposure can occur has resulted in the development of statutory national, state and local programs designed to control the handling of hazardous materials such that negative effects are reduced to a reasonable level. One series of national statutes is aimed particularly at that part of the problem related to the waste materials resulting from the production, use and disposal of chemicals. Wastes are produced at each stage, from the extraction of raw materials from the environment, through manufacture, distribution and use of products, to the ultimate discard of unused portions of those products. Persons who generate, transport, store, treat or dispose of hazardous wastes are required to limit their activities and follow quite specific procedures prescribed by law.

The Resource Conservation and Recovery Act (RCRA) of 1976 and its subsequent amendments establish a detailed framework for regulation of current management practices applied to wastes considered to be hazardous due to a variety of properties, ranging from flammability to carcinogenicity; the Toxic Substances Control Act (TSCA) created a process to control the manufacture and use of toxic materials as well as the management of the wastes associated with some of those products; the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) regulates the use of pesticides and, to a lesser degree, the disposal of associated wastes; and the Comprehensive Environmental Response, Compensation and Recovery Act (CERCLA) and its reauthorizing statute create a nationwide remedial action program to rectify past disposal practices now found to be unsuitable. Other components of the generic national environmental legislation impact the management of hazardous materials as well, e.g., the Clean Water Act, the Safe Drinking Water Act and the Clean Air Act. All of the basic environmental protection laws establish roles and responsibilities for the states and the U.S. Environmental Protection Agency (EPA) to implement the Congressional mandate.

The Pacific Northwest states (Alaska, Idaho, Oregon, Washington), while generally less industrialized than the country as a whole, are faced with a significant and perplexing share of the national hazardous waste problem. Those states, which comprise Region 10 of EPA, have created an initiative in concert with the federal agency to determine the status of Region 10 hazardous waste management practices and to stimulate cooperative interstate planning for intervention with respect to any apparent deficiencies, whether imminent or long-term.

The initiative is driven by several factors, including a need on the part of the regulatory agencies to clearly understand the scope and nature of hazardous waste generation in the region for program planning purposes; a desire on the part of legislative leaders to assure public health protection within their jurisdictions while reasonably controlling the cost of doing so; concern on the part of the regulated community regarding the dynamic nature of the programs; and certain statutory requirements for program evaluation. While the study on which this report is based arose from that entire range of concerns, the report responds largely to a specific requirement of federal law. CERCLA provides both enforcement and financial means for cleaning up "uncontrolled sites" upon which hazardous materials have been released in the past. Eligible sites are those determined to be of high relative importance on a national scale and thus placed on the National Priority List (NPL). Money from a federal remedial action account ("Superfund") can be used by EPA and the state environmental agencies to facilitate cleanup of sites for which no responsible party can be found as well as those sites which require action while responsible parties are being sought. If a state is to remain eligible for "Superfund" participation beyond October, 1989, it must certify the availability of treatment or disposal facilities for all of its hazardous wastes expected to be generated in the next 20 years, regardless of the source of those wastes. Specifically, Section 104(k) of the Superfund Amendments and Reauthorization Act of 1986 states, in part:

> "....Effective 3 years after the enactment of the Superfund Amendments and Reauthorization Act of 1986, the President shall not provide any remedial actions pursuant to this section unless the State in which the release occurs first enters into a contract or cooperative agreement with the President providing assurances deemed adequate by the President that the State will assure the availability of hazardous waste treatment and disposal facilities which --
> (A) have adequate capacity for the destruction, treatment, or secure disposition of all hazardous wastes that are reasonably expected to be generated within the State during the 20 year period following the date of such contract or cooperative agreement and to be disposed of, treated, or destroyed,
> (B) are within the state or outside the state in accordance with an interstate agreement or regional agreement of authority,
> (C) are acceptable to the President, and
> (D) are in compliance with the requirements of subtitle C of the Solid Waste Disposal Act."

Such a certification cannot be made with total reliability under any circumstances and certainly can be considered only after a state has determined the nature and volume if its aggregate waste stream; has projected the volume of that waste stream into the future based on reasonable assumptions; and has calculated the capacity of facilities expected to be available during the entire period in question. Armed with projected data of that type, the Region 10 States will have to draw conclusions, however tenuous, about their ability to independently provide the necessary facilities (through the direct action of governmental entities or by reliance on private enterprise) or to develop interstate arrangements to accomplish the purpose. This report does not constitute sufficient analysis to serve as a basis for SARA 104 (k) certification. It may, however, contribute valuable general information to the national waste disposal capacity survey and provide a stimulus for more detailed studies by the Region 10 states.

The CERCLA certification problem aside, some other factors led EPA and the Region 10 states to conclude that an assessment of the Region's hazardous waste streams and management practices should be conducted. RCRA allows EPA to authorize states to conduct hazardous waste regulatory programs in lieu of direct federal administration when certain requirements of consistency are met. In Region 10, only the programs of Oregon and Washington have been authorized by EPA, although both Alaska and Idaho perform activities in support of the federal program through cooperative agreements. Idaho operates a parallel full regulatory program pursuant to state law, and Alaska is expected to do so beginning in 1988 regardless of the status of authorization.

Moreover, no such opportunity exists for the Region 10 states to conduct TSCA-related programs on behalf of EPA, even though fragments of such state programs exist, at least with respect to regulation of the management of waste polychlorinated biphenyls (PCBs). Also, the RCRA and TSCA programs are administered somewhat separately within EPA. While the independent regulatory accomplishments of each agency are apparently high, this mixture of program splitting on the one hand and temporary duplication on the other has produced three quite predictable results: (1) the programs are not fully coordinated on a regional basis, (2) program planning documents, periodic program evaluation and status reports, and hazardous waste data displays are constructed in a variety of formats, and (3) the EPA and State analysts arrive at different conclusions due to the occasional submission of inconsistent or conflicting data for the same time periods by some waste generators and waste management entities. Further, questions arise as to the accuracy and comparability of information secured by the agencies from hazardous waste generators because the required reporting terminology is complex and nearly foreign to those persons not exposed at length to the coded jargon. Persons whose activities have been most recently covered by amendments to the federal law represent small organizations, some of which are not sophisticated with respect to environmental regulation. Data summaries derived from a multitude of individual industry reports can be poor sources of planning information unless considerable data verification is done.

The sequential implementation of various newly mandated regulations will substantially affect the volume, character and ultimate disposition of certain hazardous waste streams in the Region. Those effects must be calculated and factored into any projection of future waste management patterns. Potential amendments to the regulations in future years should also be anticipated so that all likely waste generation and management scenarios can be developed for planning purposes.

This report presents the findings of a survey of available literature which describes the character and magnitude of hazardous wastes which have been generated in Region 10 and how those wastes have been managed. It compresses data relating to all four states into one document in consistent terms and provides some limited analysis. As the time available for data collection was quite short, the review was not exhaustive nor is the report fully comprehensive. Nevertheless, it represents a step forward in consolidating information. This assessment is <u>not</u> a market survey. The information presented in this report is not purported to represent the intentions of any private or commercial entity, nor are the data suitable as a basis for planning of specific facilities. Rather, the report is to serve as a reference for general policy development and as a stimulus for more specific waste handling studies in Region 10. The objectives of the assessment follow:

1. Description of the characteristics and determination of the magnitude of the various hazardous waste streams and PCB waste streams in each Region 10 state.

2. Determination of the nature of the waste sources and generators.

3. Description of current management practices.

4. Determination of the current extent of interstate shipping of hazardous wastes.

5. Estimation of the potential for further waste reduction.

6. Projection of the effects of current and anticipated regulatory and economic factors on the future volume of the waste streams and the employment of various waste management techniques.

7. Determination of the types of technology likely to be available for handling of the region 10 wastes.

8. Estimation of available treatment/disposal capacity in Region 10 and the need for facilities in future years.

9. Determination of further data requirements for program planning.

METHODOLOGY

The assessment of hazardous waste generation and management in Region 10 was conducted during the period extending from April 1 to July 1, 1987. Information was collected by three general means: (1) review of written reports and data, (2) interviews of persons knowledgeable of hazardous waste management activities in Region 10, and (3) a limited survey of the public electric power utilities regarding PCB waste management practices.

The primary available documents which describe the nature and magnitude of hazardous waste generation and management are the biennial reports produced by EPA, the Oregon Department of Environmental Quality (DEQ) and the Washington Department of Ecology (DOE) pursuant to reporting requirements of RCRA regulations. EPA assembles the reports relating to Alaska and Idaho activities, because the regulatory programs in those states are not yet fully "authorized" by the federal agency. The Washington DOE publishes a separate annual report which provides detail and analysis beyond that required for the federal reporting system. The Idaho Department of Health and Welfare, Division of Environment (DHW) also produces an annual summary report of waste generation and disposal practices in the state. A report was prepared for the Alaska Department of Environmental Conservation by ERM, Inc. regarding 1983-84 hazardous waste generation, and an *ad hoc* task group reported on options for handling liquid wastes on Alaska's North Slope.

The biennial reports are compilations of data submitted by regulated hazardous waste generators and treatment, storage and disposal facilities (TSDF's), the most recent versions pertaining to the activities occurring in calendar year 1985. The current assessment (this report) relies largely on those 1985 reports, although conclusions regarding trends and projections are based in part on information about activities in other years. The biennial report data collection system is fraught with problems which can affect accuracy; some analysis of those problems is presented in this report. Other written references were reviewed on the subjects of waste minimization, PCB management, existing and developing treatment and disposal technology, regulatory effects, remedial action programs, and the TSDF permit issuance process. Several special computer "runs" were made from agency data processing files regarding permit applications and remedial action sites.

One new compilation of data was solicited for this report. The Defense Reutilization and Marketing Service exists for the purpose, among others, of supervising and contracting for the disposal of hazardous wastes and PCB wastes generated at active military installations. The subject wastes include those produced by clean-up projects on those active sites conducted under the Installation Restoration Program (IRP) as well as those generated routinely from ongoing military operations. Since much of that waste has been shipped out of the Region for handling, and since many of the shipments include PCB wastes and others not formally managed as "hazardous", data are not readily available regarding management patterns. The Defense Reutilization Management Office in Ogden, Utah, was asked to provide a data summary for 1985 pertaining to the military installations in the states of Region 10. That information was factored into the projections of future waste generation patterns along with estimations of waste to be produced as a result of the remedial action program of the Army Corps of Engineers which is directed toward various inactive or abandoned federal sites. Discussions were held with EPA hazardous waste program managers and staff (Regional Office; Operations Offices in the states; Headquarters); program managers and staff of the four state environmental agencies; representatives of the municipalities of Anchorage, Alaska, and Seattle, Washington; the Puget Sound Council of Governments; Seattle Metro; the Alaska North Slope Task Group; TSDF managers; industry and utility representatives; and military and other federal facility managers. Those interviews, along with documented information, provided a basis for estimating future hazardous waste generation and management patterns. Some specific sources of information will be discussed in the following sections of this report.

As TSCA regulations do not require submission of PCB generation reports to EPA or the state agencies, a mail survey of public electric utilities was conducted with the assistance of the PNUCC Utility Environmental Committee and the Pacific Northwest Public Power Association. Respondents provided estimates of past and future PCB generation and disposal volumes. That information supplemented available national PCB data and local TSDF data such that reasonable estimates of the future PCB generation pattern and management facility needs could be estimated.

The 1985 hazardous waste generation and management data were divided (or combined) into common categories as much as possible for display in this report. As the state agency reports vary in level of detail, that exercise required the application of assumptions and estimations; therefore, virtually none of the reported values should be considered to be absolute.

The data produced in this fashion constitute a baseline from which projections were attempted in consideration of the following additional factors:

1. Small quantity generator wastes
2. Household waste generation and disposal
3. Waste minimization programs
4. Regulatory effects
5. Economic growth
6. Remedial action programs

The projected generation pattern was then compared to the capacity of the apparently available and proposed management facilities within Region 10 to determine potential deficiencies. The applicability of various types of treatment and disposal technology to the specific waste groups and volumes produced in Region 10 was generally assessed. Discussion of each of the aforementioned factors is presented in the following sections of this report.

Since most of the data presented in this report were extracted from regulatory program reports which pertain to a prescribed range of chemical substances, strict definitions of certain terms must be recognized; hence, waste generation data displayed in this report describe only those materials regulated by the agencies as "hazardous waste", and hazardous wastes are discussed separately from PCBs. However, recognizing that waste management problems and solutions are multimedia in nature (air, water, land) and that the commercial application of facilities may involve non-regulated wastes, this report also includes discussion of waste generation and management in a broad sense.

HAZARDOUS WASTE GENERATION

Wastes listed by EPA as hazardous at certain concentrations and those with specific dangerous characteristics are tracked and regulated from generation to final disposition by EPA or the state agencies under the provisions of RCRA or companion state statutes. "Characteristic" wastes are those which exhibit properties of ignitability, corrosivity, reactivity and toxicity. Listed wastes include generic chemical groups from non-specific sources; conglomerate wastes from specific sources (mostly manufacturing); and discarded commercial chemical products, off-specification products, container residues and spill residues of those materials.

Originally, the federal program applied to all wastes in the amount of 2200 pounds (1000 Kg) or more produced in a month or accumulated at any time by a person. Lesser amounts of extremely toxic materials were also regulated. RCRA amendments adopted in 1984 reduced the regulated amount to 220 pounds (100 Kg). Those persons who produce 2200 pounds of waste per month or accumulate that amount are referred to as "major generators".

At the outset of the federal program, all persons who expected to handle regulated amounts of hazardous waste were required to register with EPA and receive an identification number. Those numbers appear on manifests which accompany each hazardous waste shipment and serve as identification of the entities which generate, transport, store, treat or dispose of those wastes. All regulated wastes generated in amounts of 220 pounds per month or greater must be stored (if more than 90 days), treated or disposed of at a facility approved for that purpose by the appropriate regulatory agency. Federal rules require regulated facilities and registered generators and handlers of hazardous waste to file biennial reports with EPA or state agencies. State agencies with "authorized" programs must compile the information and report to EPA.

Major generators must report the quantity of waste shipped from their premises and list the destinations. Those who produce between 220 and 2200 pounds of waste per month or accumulate that amount are termed "small quantity generators" (SQG); they are required only to report that they fall in that category for the year in question, although their wastes must be handled by approved hazardous waste facilities and shipments must be manifested. (requirement began September 8, 1986). The regulations of the State of Washington establish major generators as those who produce greater than 400 pounds of waste per month. Reporting and waste management requirements therefore reach a larger fraction of the waste-generating community than in the other three states.

Persons who reclaim materials on-site or ship certain wastes such as lead-acid batteries and solvents off-site for recycling must only report that they are exempt from further regulation. Those who generate no regulated waste in a given year must so report. If no such wastes are expected to ever be generated, a person can formally apply for removal of his name from the list of registrants. Household wastes, though often containing materials defined as "hazardous", are exempt from regulation and maintain that identity regardless of amounts accumulated at any point from any number of sources. Although some municipalities have established projects for periodic collection of household hazardous wastes for treatment or permanent disposal, most such wastes are taken (legally) to public landfills where their disposition may or may not be "permanent". Most of those landfills are not "secure" in the sense that no liners are required and, in most cases, no groundwater monitoring system is yet in place.

SOURCES OF HAZARDOUS WASTE

This study examines waste generation and handling in Region 10 by establishing 1985 as the base year from which to make projections; the most current biennial reports relate to that year. Hazardous waste is produced by a fairly broad spectrum of sources in the region, ranging from large industrial plants to individuals.

The reported number of registered generators in the region during 1985 was 2689. Table 1 displays the status of those entities as determined by the biennial survey. Only 882 (33%) were major generators of hazardous waste. Seventy percent of the region's major generators were in Washington (623), 23% in Oregon (206), 4% in Idaho (30) and 3% in Alaska (23). Another one-third of those who were registered produced no regulated hazardous waste in 1985 (much higher percentages in Alaska and Idaho), while 13% reported as small quantity generators. Note that other SQG's exist in the region, but they did not register. Ten percent of the registrants claimed exempt status and an equal number either did not respond or reported that their businesses were closed or had been sold. Most of the non-responders were transporters who were not actually required to report.

TABLE 1

REGISTERED GENERATOR STATUS, REGION 10, 1985 (NUMBER)

	AK	ID	OR	WA	Total	%
Major Generator	23	30	206	623	882	33
Small Quantity Generator	14	58	80*	188	340	13
No Waste	61	163	250*	452	926	34
Exempt	18	43	75*	138	274	10
No Response				195	195	7
Closed or Sold	35	5	10*	22	72	3
Total	151	299	621	1618	2689	100

* Estimated

TABLE 2

CATEGORIES OF MAJOR GENERATORS, REGION 10, 1985 (NUMBER)

Source	AK	ID	OR	WA	REGION 10
Manufacturing					
Chemicals		1	25	43	69
Metalworking		1	45	80	126
Electronics		3	35	30	68
Wood Products		1	32	23	56
Prim. Sec. Metals			12	21	33
Petroleum Ref.	3		1	8	12
Transport Eqp.				43	43
Misc. Mfg.		3	2	92	97
Subtotal	3	9	152	340	504
Trade, Services, Govt.	8	10	41	194	253
Transportation	5	7	12	41	65
Military	4			45	49
Mining	3	1		3	7
Electric Utilities		3	1		4
Subtotal	20	21	54	283	378
Total	23	30	206	623	882

The major generators represent most elements of industrial and community activities in the region, including manufacturing, trade, services, government, military, transportation, mining (including oil extraction) and electrical utilities. Manufacturing companies (504; 57%) and trade, services and governmental organizations (253; 29%) dominated the list of major sources in 1985 (Table 2). The manufacturing category included a large number of metalworking companies (126; 14.2%); other categories most frequently represented were chemicals (69; 7.8%), wood products (56; 6.3%), electronics (68; 7.7%), and transportation equipment (43; 4.9%). The manufacturing group most strongly dominated the list of sources in Oregon and Washington, where 74% and 55%, respectively, of the generators were of that type (Figures 3 and 4). Most other Oregon generators were in the trade, services, transportation, and governmental sectors (no military or mining sources). The Washington pattern was similar except for the presence of significant military sources.

In Alaska, a balance of source types was seen as is evidenced by Figure 1. Trade, services and government accounted for 35% of the generators, while military, manufacturing, oil extraction and transportation had nearly equal shares of the remaining number. The only manufacturing units producing major amounts of hazardous wastes were related to oil refining. A greater number of generators than that shown in the biennial report may have produced regulated amounts of hazardous waste in 1985. A review of the individual hazardous waste management facility reports reveals that the waste from about 20 additional generators was disposed of by injection well on the North Slope and managed by that facility as hazardous waste. No generator reports exist for most of those wastes, perhaps because the wastes were not tested for hazardous characteristics by the sources and were assumed not to be regulated.

Figure 1
Categories of Major Hazardous Waste Generators
Number and Percentage of Sources

Alaska

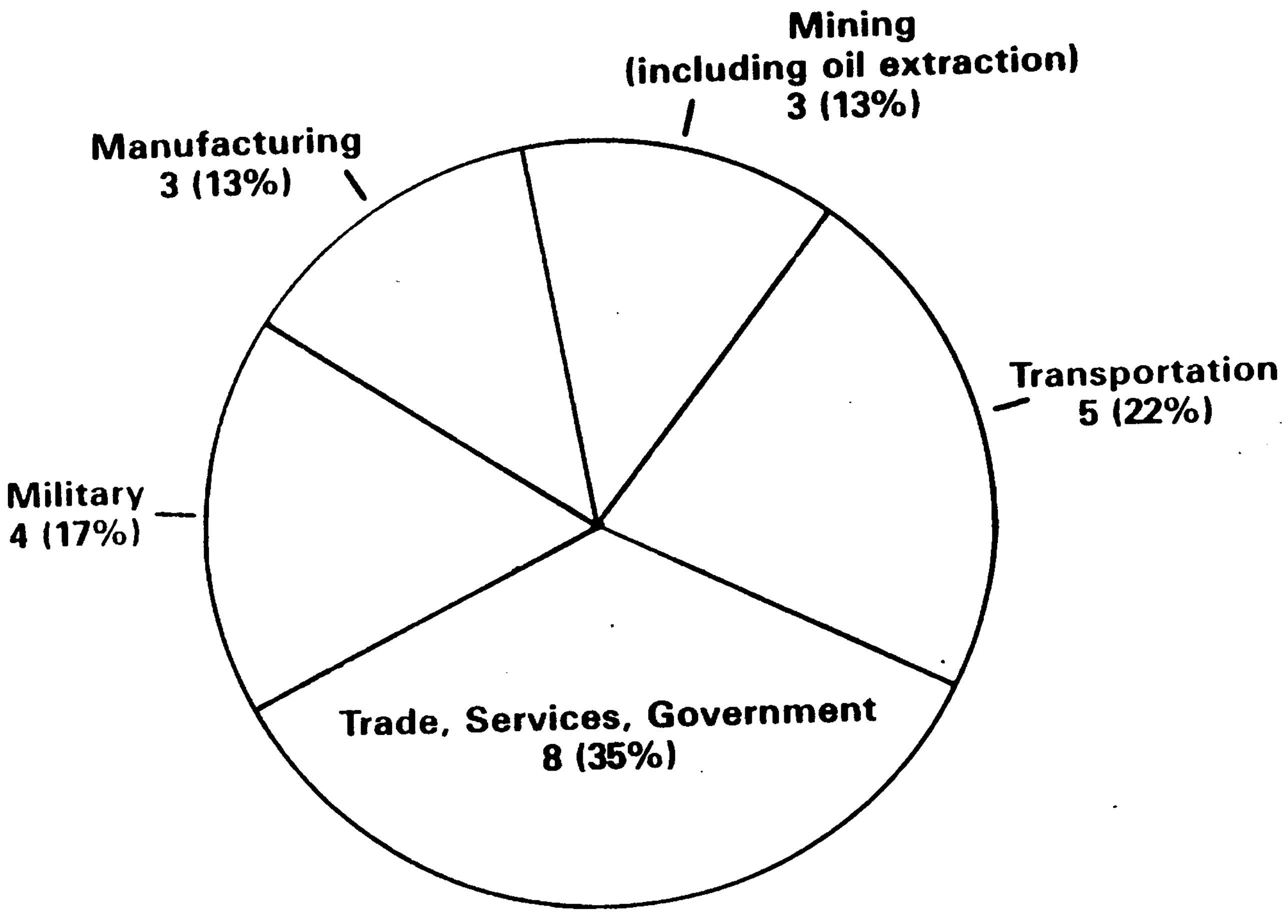


Figure 2
Categories of Major Hazardous Waste Generators
Number and Percentage of Sources

Idaho

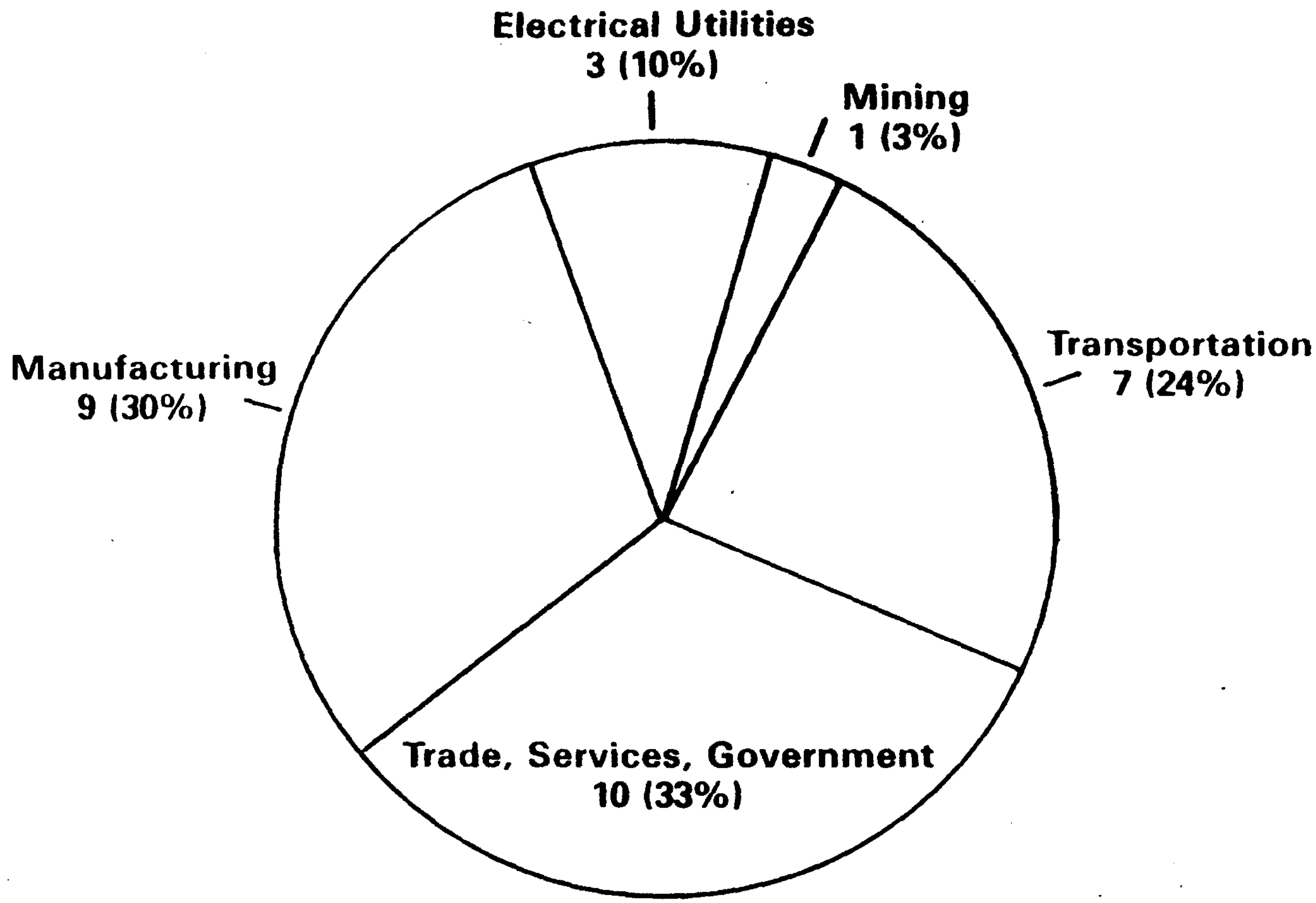


Figure 3
Categories of Major Hazardous Waste Generators
Number and Percentage of Sources

Oregon

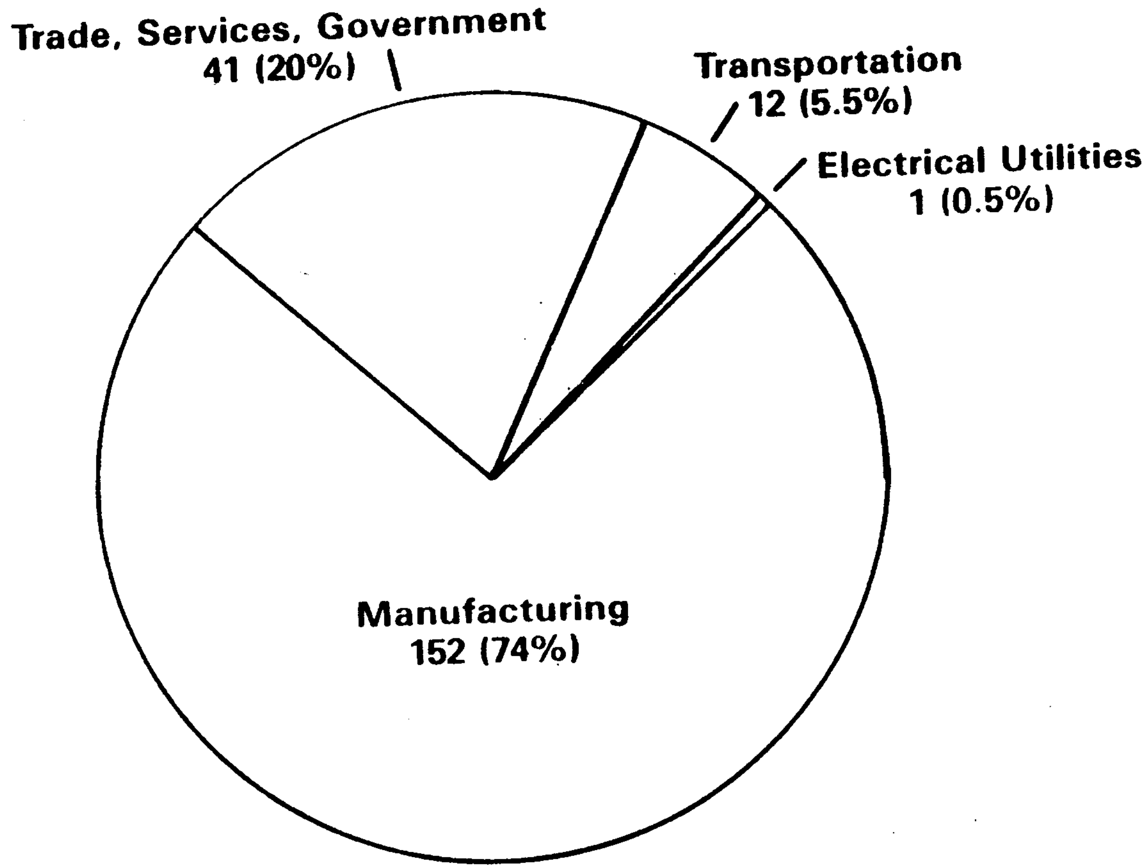
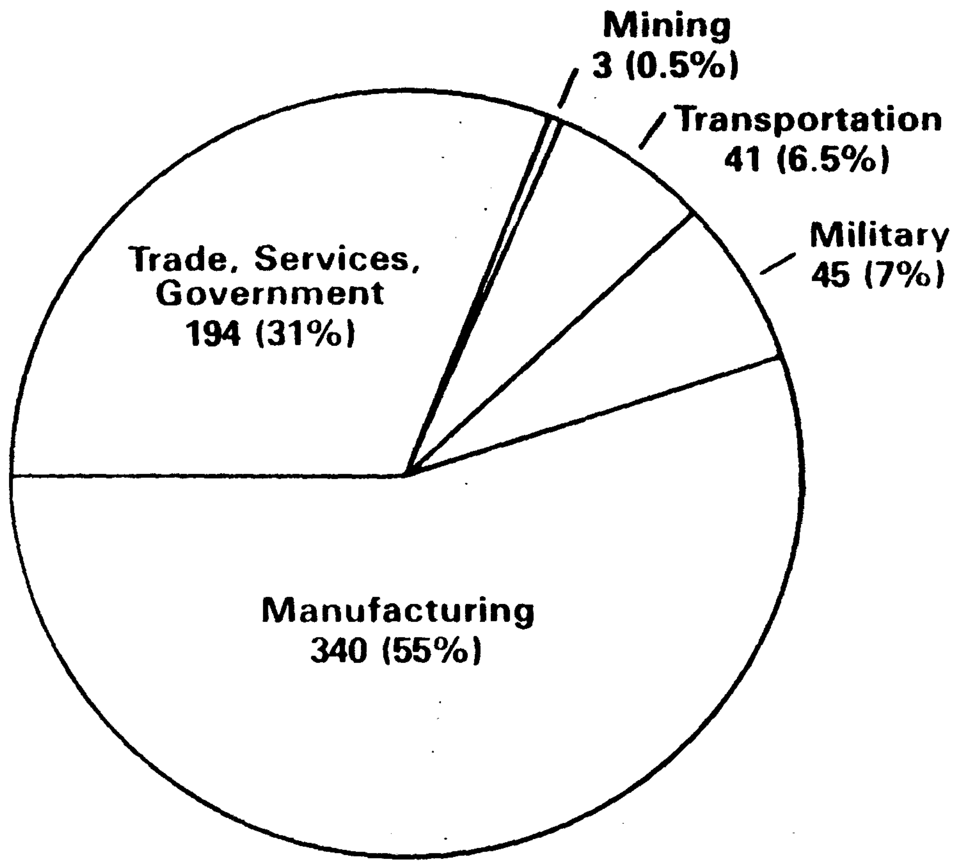


Figure 4

Categories of Major Hazardous Waste Generators

Number and Percentage of Sources

Washington



The actual number of oil extraction (mining) generators in Alaska in 1985 may have been 40-45.

Manufacturing plants made up nearly one-third of Idaho's generators, with trade, services and government accounting for another one-third (Figure 2). The largest number of manufacturers were electronics plants. Transportation and electrical utilities constituted most of the final one-third of the sources.

The major generators in Region 10 reported the production of 545,158 tons of hazardous waste in 1985 (Table 3). Over 85% of that waste was from the manufacturing sector (466,057 tons). Most of the remaining 79,101 tons came for military installations (60,255 tons). Washington reported 514,713 tons, which amounted to over 94% of the region's waste; Oregon generated 26,813 tons (5%), while Idaho and Alaska added a miniscule 0.6% to the total. However, that relationship was skewed substantially by the inclusion in the Washington report of wastewaters which were treated on-site and discharged to surface waters or were sent to municipal sewage treatment plants following pretreatment. The ultimate discharge of those wastewaters in both situations was regulated by permits issued pursuant to provisions of the Clean Water Act (NPDES). As the RCRA regulations exempt such wastewater from reporting requirements, no such wastes were reported in Oregon, Alaska or Idaho. However, since Washington requires reporting of those streams as hazardous wastes, they were included in the biennial report.

Some residuals resulted from pretreatment of the wastewater discharged to public sewers, but those were reported separately. Much of the Washington wastewater (136,400 tons) was produced by one aluminum reduction plant.

TABLE 3

REPORTED HAZARDOUS WASTE GENERATION BY MAJOR SOURCES, 1985

	Tons Generated				
Source	AK	ID	OR	WA	REGION 10
Manufacturing					
Chemicals		142	1009	27,204	28,355
Metalworking		264	2718	58,513	61,495
Electronics		607	9071	608	10,286
Wood Products		166	1149	1252	2567
Prim. Sec. Metals			8774	281,509	290,283
Petroleum Refining	13		3	4993	5009
Transportation Equipment				28,127	28,127
Misc. Manufacturing		47	6	39,882	39,935
Subtotal (Manufacturing)	13	1226	22,730	442,088	466,057
Trade, Services, Govt.	225	394	2519	6552	9690
Transportation	210	164	1290	059	7723
Military	65		273	59,917	60,255
Mining (incl. oil production)	1096	19		5	1120
Electric Utilities		221	1	16	238
Other				76	76
Subtotal (Non-Manuf.)	1596	798	4083	72,625	79,102
Total	1609	2024	26,813	514,713	545,159

As that wastewater contained only one pollutant (hexavalent chromium) and neither the effluent nor the sludge resulting from treatment are toxic, the exclusion of all NPDES wastewaters from the Washington hazardous waste total when comparing waste generation patterns is easily justified. Non-wastewater hazardous waste in the region totaled 228,910 tons. Table 4 details the magnitude of hazardous waste generation from source groups in the four states. Without wastewater, the remaining manufacturing wastes still dominated (179,263 tons; 86%). Washington's 198,464 tons of waste also still dwarfed that of the other states (86.7%); Oregon contributed 11.7%; Idaho 0.9%; and Alaska 0.7% (Figure 5).

Figure 6 shows the distribution of sources and amounts of hazardous wastes in the region. Primary and secondary metals industries, mostly in Washington, produced the largest fraction of the waste in 1985 (85,811 tons; 37.5%); stone and clay products companies (34,794 tons; 15.3%), transportation equipment manufacturers (26,246 tons; 11.5%) and chemical plants (23,638 tons; 10.3%) also contributed substantial shares. Alaska's wastes were chiefly related to the oil production industry; electronics companies produced the largest percentage of Idaho's wastes; and Oregon's primary waste generators were the electronics and metals manufacturing industries.

Although the figures presented in this report reasonably portray the magnitude and nature of hazardous waste production in 1985, the pattern of generation over time has not been and will not be stable. Trend analysis is hampered by an inability to clearly differentiate between the actual generation fluctuations and the changing regulatory scope. The reported Washington wastes (non-wastewater), for example, have varied by 30% between

TABLE 4

REPORTED HAZARDOUS WASTE GENERATION, REGION 10, 1985
(EXCLUSIVE OF NPDES WASTEWATERS)

TONS GENERATED

Source	AK	ID	OR	WA	REGION 10
Manufacturing	131	1226	22,730	173,293	197,262
Trade, Serv., Govt.	225	394	2519	6552	9690
Transportation	210	164	1290	6059	7723
Military	65		273	12,463	12,801
Mining	1096	19		5	1120
Elect. Utilities		221	1	16	238
Other				76	76
Total	1609	2024	26,813	198,464	228,910

TABLE 5

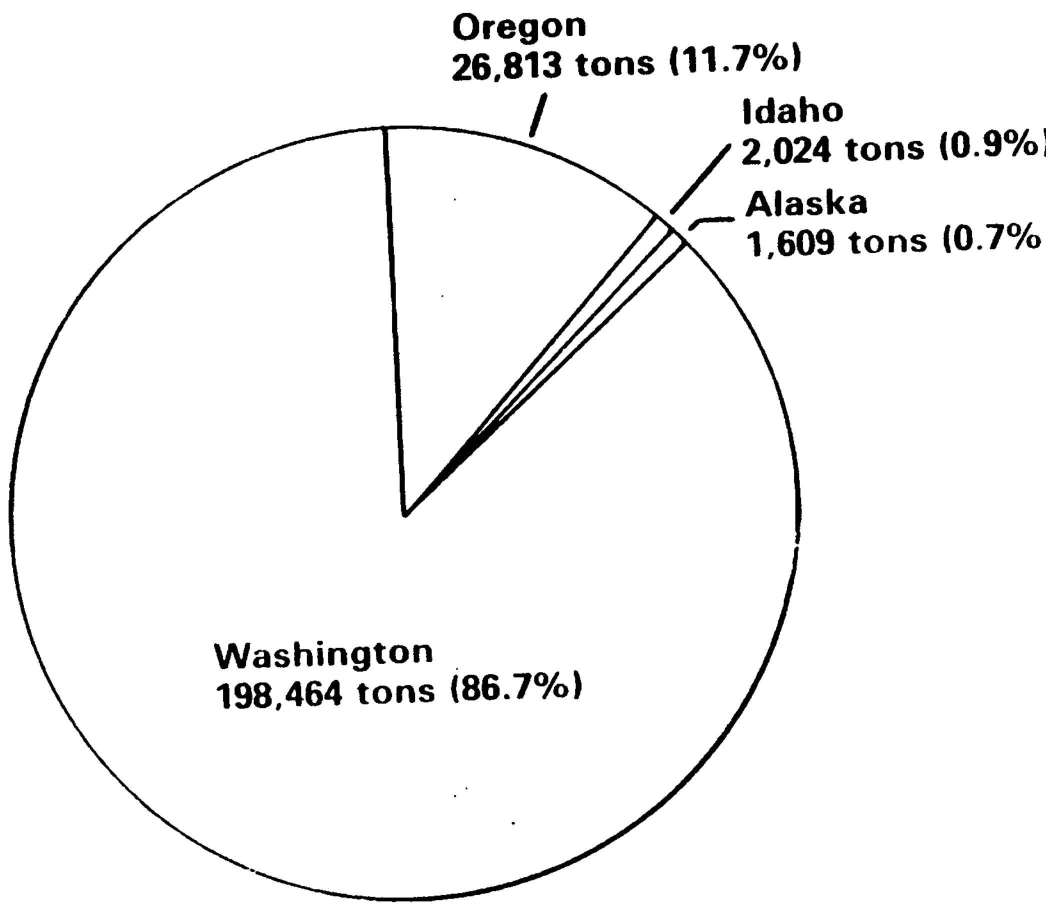
PHYSICAL COMPOSITION OF HAZARDOUS WASTE, WASHINGTON, 1985[1]

	Inorganic		Organic		I/O Mixture		Total	
	Tons	%	Tons	%	Tons	%	Tons	%
Sludge	54,218	27.3	7153	3.6	21,471	10.8	82,842	41.7
Liquid	17,543	8.8	10,729	5.4	6076	3.1	34,348	17.3
Solid	72,609	36.6	4241	2.1	4424	2.3	81,274	41.0
Total	144,370	72.7	22,123	11.1	31,971	16.2	198,464	100

1. Does not include NPDES wastewaters

Figure 5

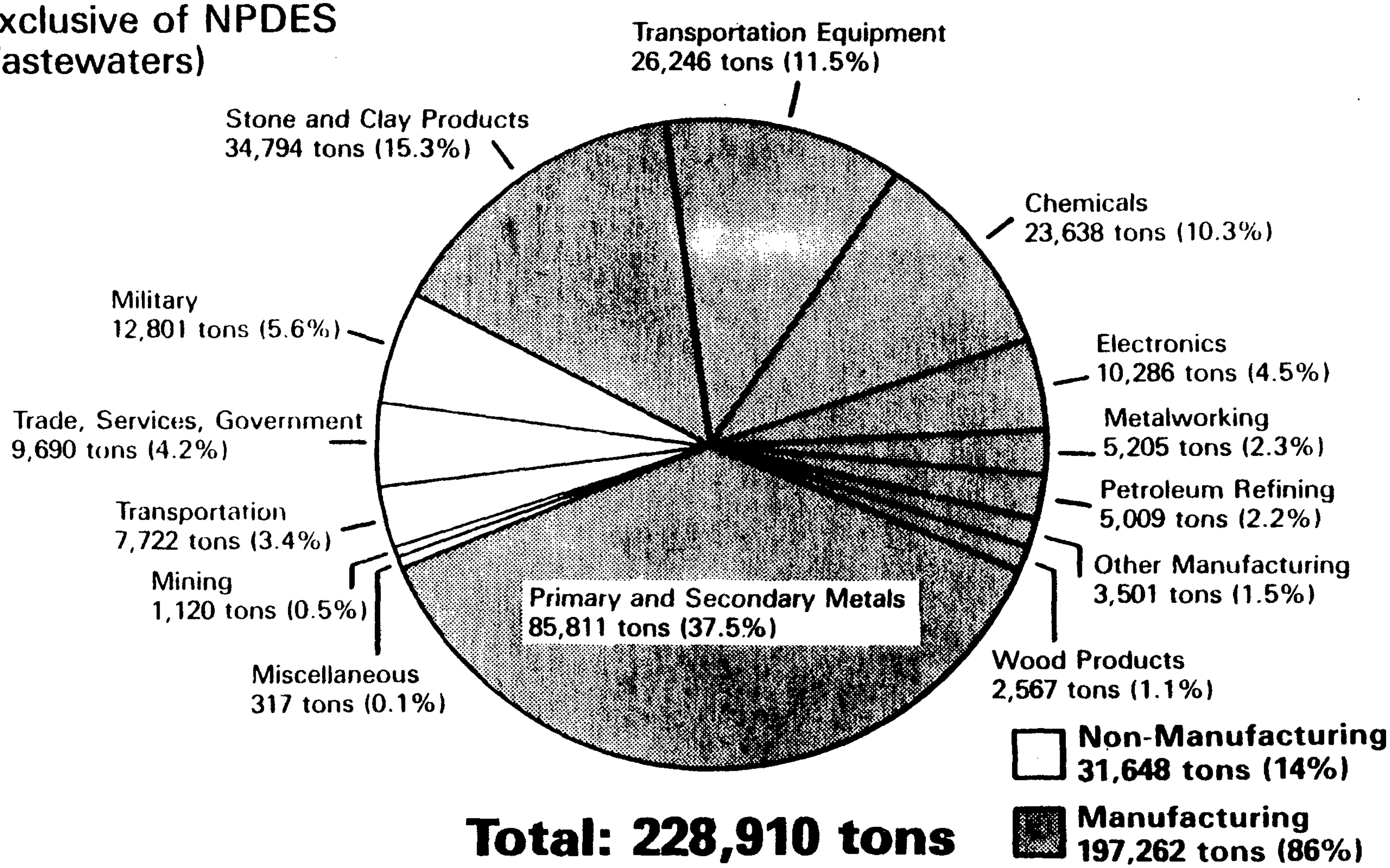
Hazardous Waste Generation, Region 10, 1985
(Exclusive of NPDES Wastewaters)



Total: 228,910 tons

Figure 6

Hazardous Waste Generation, Region 10, 1985
(Exclusive of NPDES Wastewaters)



the years 1982 - 1985, due in part to the regulation of additional categories of waste. An equally important factor is the sporadic nature of waste production from cleanup projects of various kinds. Total waste volumes from those sources in Washington have fluctuated more than an order of magnitude from one year to another. The volume of Idaho wastes for 1986 is already known to have been about 33% less than in 1985, partially because of a difference in site cleanup wastes. Some cleanup projects produce materials that are regulated hazardous wastes and those are therefore reported by the generators. Other cleanup wastes are not designated as hazardous, but are nevertheless sent to hazardous waste disposal facilities. Those wastes are not necessarily reported by generators.

Certain components of the major source waste streams and relevant unreported or unregulated waste streams generated during the 1985 base-year are discussed in the following paragraphs. Projections of future waste production with respect to those components are made in a later section of this report.

Recycled Wastes

The limited RCRA reporting requirements render impossible an estimate of hazardous waste volumes destined for recycling. While a small fraction of the waste reported by regulated generators is actually recycled rather than treated or disposed of, most such wastes are not reported due to the regulatory exemption. Some recycling of spent solvents and petroleum products occurs in the region, but to a lesser degree than several years ago, prior to the failure of a major recycling facility in Washington. Reprocessing of lead-acid batteries continues in Oregon.

The types of waste currently being recycled will probably not be shifted to any other handling mode, so an accurate determination of the current recycling volume is not instrumental in the assessment of treatment and disposal capacity needs. However, the capability to add recycling capacity may be important as conventional disposal methods are disallowed for certain wastes.

Remedial Actions

A substantial portion of the reported regulated hazardous waste results from remedial actions at NPL (Superfund) sites, RCRA-regulated cleanup projects, state regulated or assisted site cleanups, and transportation-related spill cleanups. As previously pointed out, some of those wastes are not reportable by regulated generators, but are accounted for by the facility reports.

A perusal of the Alaska and Idaho individual generator reports for 1985 allowed an estimate of the fraction of reported tonnage resulting from cleanup of spills and remedial actions of some kind. Approximately 14% of the Idaho wastes and 10% of the Alaska wastes fell into that category. Washington DOE staff reported that about 1400 tons of waste resulted from cleanup projects in 1985 (0.7% of the non-wastewater total). Note, however, that the reported value for 1984 was tenfold higher. No estimate is available for Oregon.

Small Quantity Generators

Small quantity generators were not required by RCRA regulations to send wastes to approved hazardous waste management facilities in 1985, nor were they asked to report the specific amount of waste generated. Some SQG's shipped waste to regulated facilities in 1985 anyway, and were required to do so after September, 1986. It is important to know the approximate amount of SQG waste generated in the region during the base-year so that it can be factored into estimates of waste production and disposal capacity needs.

National data indicate that 98% of the total number of generators are SQGs, but that they produce less than 1% of the total waste. In Region 10, the SQG's theoretically contribute a slightly smaller share, because the State of Washington defines major generators as those producing 400 pounds or more of waste, while RCRA establishes the cutoff at 2200 pounds. National data also establish that three-fourths of the SQG's are located in Metropolitan Statistical Areas, and that less than 15% are manufacturing industries.

About one-half of the SQG's are vehicle maintenance businesses, and 60% of the total waste is lead-acid batteries (90% of which are recycled). Solvents account for approximately 20%, and strongly acidic or alkaline wastes amount to about 5%. Most SQG's ship waste off-site, where the most common management method is recycling (2/3). One-fifth of the SQG's manage waste on-site (mostly RCRA-exempt disposal to public sewers) and the remainder treat on-site and then dispose of residuals off-site.

Through disaggregation of national data on the basis of urban population, and adjustment for the Washington definition, one can estimate that the SQG's of the Region 10 states generate about 11,000 tons per year of hazardous waste other than batteries, 5400 tons of which are solvents and 1500 tons are acids/alkalies. This method of estimation would assign over 7000 tons per year to Washington SQG's, 3000 tons to Oregon, 600 tons to Idaho and 400 tons to Alaska. Those figures seem high in relation to the amount of waste produced by "major" generators, but that is to be expected, because the Region 10 states' major generators produce less waste than the national average on a per capita basis.

An Anchorage, Alaska, SQG survey provides an estimate of 330 tons per year of waste produced in that city. Only one-half of the potential SQG's responded, and the estimate is probably low. However, the number is a reasonable estimate of the actual waste total exclusive of batteries. Projection of that figure to the total population of the region yields 12,000 tons, which is remarkably close to the 11,000 ton estimate derived from national data.

Much of the SQG waste is recycled, but it is difficult to determine the percentage. A study of King County, Washington, non-regulated hazardous waste conducted for the Puget Sound Council of Governments (PSCOG) concluded that about 5100 tons of potentially hazardous wastes were discarded (not recycled) by commercial and industrial SQG's in 1985. Two-thirds of those materials were weak bases which would likely not meet the standard test for hazardous characteristics. The remaining tonnage (1700) might represent a good estimate of the fraction of SQG wastes which were not recycled in 1985. Applying such a factor to the 11-12,000 ton estimate of SQG waste in the region, one might conclude that 3500-4000 tons of such waste were handled by public solid waste management facilities. That amount can be added to the reported major generator waste when considering possible disposal options.

Household Waste

Unregulated household hazardous wastes are diverse and quite voluminous; most are taken to public landfills. The PSCOG study placed the household hazardous waste of King County at 5896 tons in 1985. An extrapolation of that figure to all of the households of the region provides an estimate of 35,000 tons. National studies have determined household hazardous waste generation at about 40 pounds/household/year. Application of that factor would produce an estimate of 56,000 tons for the region in 1985. Allowing for substantial error, the actual amount may have fallen in the range of 30,000 to 60,000 tons. Perhaps one-half of that amount could be accessible for special management if intensive urban collection programs are developed.

WASTE CHARACTERIZATION

About 700 specific chemicals have been listed by EPA as hazardous when present in waste materials. Various other waste components, when present in sufficient concentration, will produce hazardous characteristics. EPA and the Region 10 state agencies have described specific waste sources and waste types which are regulated in addition to the EPA-listed chemicals. Thus, the total number of chemical elements, compounds, and designated waste types reaches well over 1000.

One hundred sixty-five of those specific waste types were generated in Region 10 in 1985. Washington reported wastes with 103 separate substances or waste types, 36 of which were present in amounts of one ton or more. Oregon's total was 62, of which 52 reached a ton or more. Ninety-four substances or waste types were produced in Idaho, but only 26 were present in the amount of one ton or more. In Alaska, 36 waste types were identified, 21 amounting to a ton or more.

While it is important to determine the presence of each specific substance and regulated waste type for analytical purposes, one must recognize that many of the actual waste materials are mixtures of substances and that the wastes may exist in different physical states. Applicable storage, treatment and disposal techniques will depend on the nature of the waste (pure liquid, dry solid, sludge, aqueous solution, emulsion, etc.). Unfortunately, the standard EPA biennial data collection system does not provide such information; however, the Washington DOE does request data from generators regarding the physical state of wastes, and the 1985 DOE annual report includes that information. It breaks down the wastes in terms of liquids, solids and sludges, both organic and inorganic. That pattern probably approximates the physical characteristics of wastes in the other Region 10 states except Alaska, where the predominant wastes are oily aqueous solutions.

The 1985 Washington data are presented in Table 5 (page 24). Nearly three-fourths of the wastes (exclusive of wastewaters) were inorganic, and much of the remainder was inorganic/organic mixtures (16.2%). Solids and sludges prevailed equally, totaling 41.0 and 41.7%, respectively. About one-fourth of the materials were potentially combustible and 31% of those combustibles were liquids.

In the interest of considering applicable technology, it is convenient to group the wastes by general chemical character or by industrial source. The methodology of this survey did not allow for detailed groupings based on strict treatability factors, but a basic breakdown of the 1985 Region 10 data was attempted. Tonnages of general waste groups are shown in Table 6 and the percentage distribution is displayed in Table 7. Note that the State of Washington regulates as hazardous some wastes not so classified by RCRA regulations. Over one-half of the hazardous wastes reported by Washington fell into that category. Those materials were found to be toxic by bioassay techniques and some were also corrosive. Specifically, those wastes consist of such materials as cement kiln dust, furnace black dross and potlining from the aluminum industry, boiler fly-ash from the wood products industry, and fluxing salts from magnesium reduction. Washington also designates PCBs below 50 parts per million (ppm) as hazardous waste. The State of Oregon also regulates certain wastes based on bioassay techniques, but those were a relatively minor factor in 1985 compared to the Washington situation.

Most of the waste groups in Tables 6 and 7 are not mutually exclusive, i.e., a particular waste might fall into more than one category. For example, certain corrosives are often contaminated with heavy metals and would be

TABLE 6

CHARACTERIZATION OF HAZARDOUS WASTE, REGION 10, 1985 (TONS)[1]

Major Waste Types	AK	ID	OR	WA	REGION 10
Metals	594	256	4314	28106	33270
Non-Chlorinated Solvents	30	62	675	8272	9039
Chlorinated Solvents	42	74	2041	3228	5385
Other Halogenated Organics		3	928	23	954
Misc. Organics	178	24	734	282	1260
Ignitables (N.O.S.)[2]	674	67	3040	2872	6653
Corrosives	8	296	5683	14643	20630
Reactives	1	11	270	148	430
Pesticides[3]		406	1026	3190	4622
Electroplating Sludges (CN-)		340	3294	15049	18683
Petroleum Residuals	14	20	37	6677	6748
Steel Emission Control Dust			2998	6342	9340
Steel Spent Pickle Liquor			115	4516	4631
Aluminum Coating Sludges			34	633	667
Misc. Inorganics	68	465	1624	92	2249
Washington Reg. Wastes				104,349	104,349
Total	1609	2024	26813	198,464	228,910

1. NPDES Wastewaters not included
2. Not otherwise specified
3. Including wood preservatives

TABLE 7

CHARACTERIZATION OF HAZARDOUS WASTE, REGION 10, 1985 (PERCENTAGE)

Type	AK	ID	OR	WA [1]	WA [2]	REG. 10 [3]	REG. 10 [4]
Metals	37	13	16	14	30	14	27
Corrosives	0.5	15	21	7	16	9	17
Electroplating Sludge	0	17	12	8	16	8	15
Steel Emissions Dust	0	0	11	3	7	4	8
Non-Chlor. Solvents	2	3	2.5	4	9	4	7
Ignitables (N.O.S.)	42	3	11	1.5		3	
Petroleum Residuals	1	1	0.1	3		3	
Chlorinated Solvents	2.5	4	8	2		2	
Steel Spent Pic. Liq.	0	0	0.4	2		2	
Pesticides	0	20	4	1.5		2	
Misc. Inorganics	4	22	6	0.1		1	
Misc. Organics	11	1	3	0.5		1	
Other	0	1	5	0.4		1.5	
Washington Reg.				53		46	
Total	100	100	100	100		100	

1. Washington percentage including wastes regulated only by Washington.

2. Washington percentage without wastes regulated only by Washington.

3. Region 10 percentage including wastes regulated only by Washington.

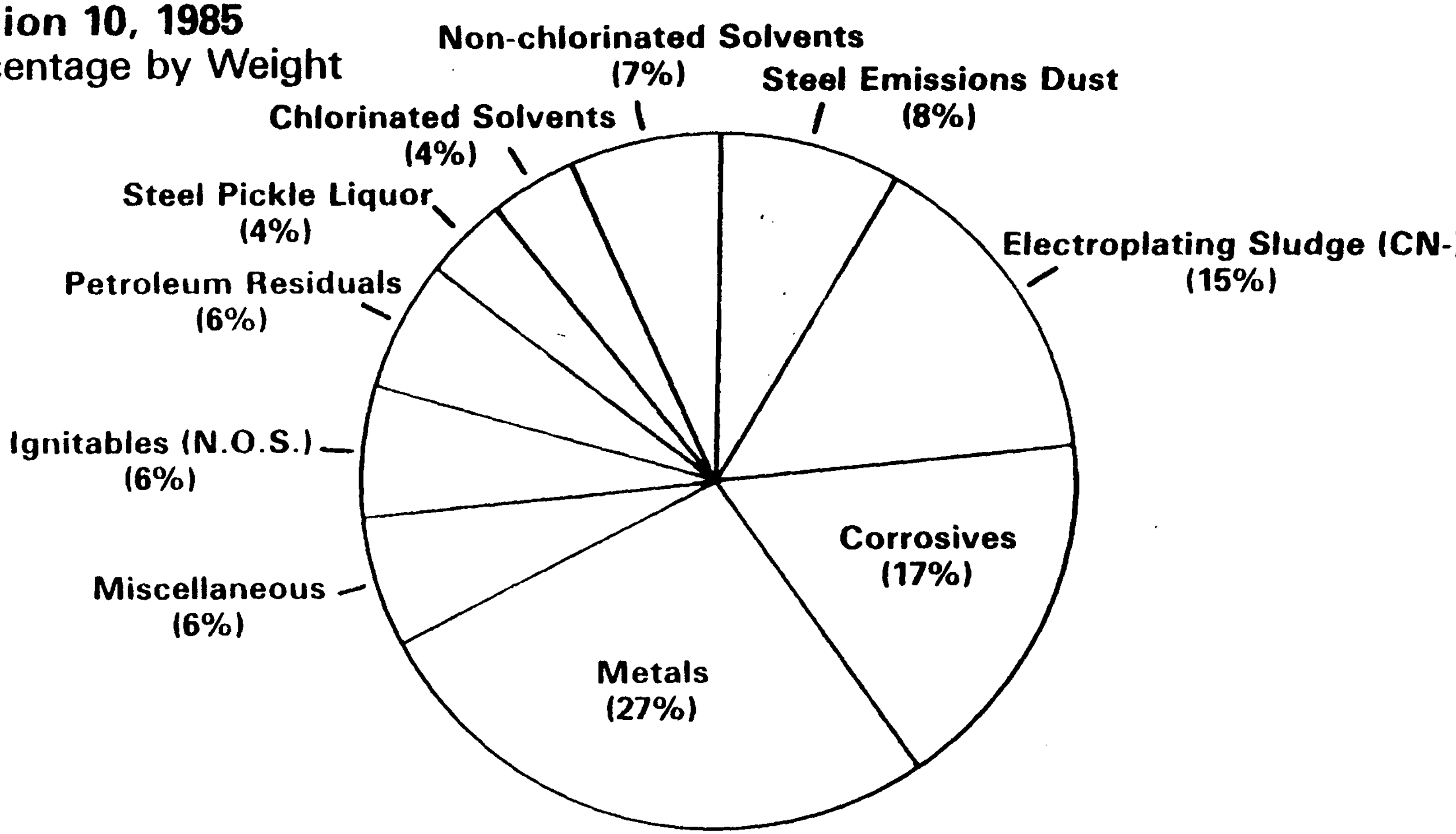
4. Region 10 percentage without wastes regulated only by Washington.

regulated due to either factor. The designations chosen for the Tables are based on the waste element or characteristic reported by the generator as dominant in each waste (in some cases, it is simply the first of several waste codes listed in the generator report). For ease of comparison of RCRA-regulated waste generation in all four states, Table 7 includes waste group percentages for Washington calculated with and without the wastes regulated only by that state. Figure 7 graphically presents the distribution of RCRA-regulated wastes in the region, exclusive of the wastes regulated only by Washington.

As mentioned earlier, nearly one-half of the region's hazardous wastes in 1985 were the Washington-only wastes. Otherwise, the dominant categories were metals, corrosives, electroplating sludge (usually containing cyanide), steel plant emissions dust, and non-chlorinated solvents, with lesser amounts of ignitable materials not otherwise specified, petroleum residuals, chlorinated solvents, steel plant spent pickle liquor, pesticides, and miscellaneous organic and inorganic substances. The relative volumes of those wastes are quite similar in all states except Alaska.

In Alaska, most of the 1609 tons of waste reported in 1985 was associated with activities in the oil fields. Corrosive liquids with metals constitute a large fraction of the wastes from those sources, along with aqueous oily wastes and solvents from such practices as equipment and truck cleaning. Some of the wash water is contaminated only by motor oil, gasoline or diesel, but is classified as hazardous waste due to low flash point or high concentration of lead. The report of the Alaska North Slope Task Group leads one to conclude that regulated hazardous wastes generated in that state may well have

Figure 7
Characterization of Hazardous Waste, Region 10, 1985
Percentage by Weight



been closer to 6000 tons in 1985, rather than the 1609 tons shown in the biennial report. That conclusion is based on representative testing of wastes disposed of at the Prudhoe Bay Unit injection well. Hazardous wastes from other parties (non-Unit) were received for disposal there (until August, 1985) along with wastes assumed not to be regulated. The testing established that about 35% of the volume of all non-Unit wastes was hazardous. If 35% of the 7500 tons of non-Unit wastes delivered to the injection well by August, 1985 was in fact hazardous, then those wastes must have been generated at a rate of about 4600 tons per year at that time.

Alaska industries generate large volumes of non-hazardous wastes which are important when considering overall disposal options. In 1985, about 31,000 tons of oily wastewater were produced by oil exploration processes. Those wastewaters, which were also injected into deep wells, are specifically excluded from classification as hazardous by the RCRA regulations. Petroleum refining also generated large amounts (20-30,000 tons) of process wastewater which is treated on-site by an oil/water separator. Those waste streams are either recycled or discharged under NPDES permit and are therefore not regulated by RCRA.

Idaho's predominant 1985 hazardous wastes fell into the category of pesticides (406 tons; 20%) but that will prove to be an anomaly. Well over half of the pesticide wastes reported in that year came from a groundwater treatment project involving spilled creosote; the bulk of the remaining reported pesticides was pentachlorophenol-contaminated material from wood treating operations. Otherwise, the leading waste categories in Idaho were electroplating sludge, corrosives and metals.

The Oregon list is led by corrosives (21%), followed by metals (16%) and electroplating sludge (12%). A substantial amount of steel plant emissions dust was generated as well as an equal amount of ignitable material of unspecified nature.

As previously noted, the reported Washington wastes were largely those regulated only by that state (53%); metals constituted the next largest category, followed by electroplating sludge and corrosives.

Overall, it is apparent that the Region 10 hazardous waste streams consist mainly of solid and semisolid inorganic materials which are fairly stable chemically and are amenable to relatively uncomplicated management options. However, a small, but very significant organic fraction also occurs in various physical forms and sometimes is mixed with inorganics, including metals, presenting a complex management problem.

DISPOSITION OF HAZARDOUS WASTE

The handling of hazardous waste in the United States is a dynamic process which reacts over time to a variety of influences--some economic, some regulatory, and others, cultural. Materials now considered to be dangerous, and therefore deserving intensive regulation and specific handling procedures, were for all time prior to the 1970's managed in any way chosen by the persons who owned them, sometimes receiving the same level of care as that accorded municipal refuse and sometimes much worse. Many "superfund" sites in the country stand as testimony to the latter condition.

Better and more coordinated strategies have arisen in the form of national, state and local legislation designed to reasonably separate the people and their environment from hazardous substances. The technical means of doing so range from refraining from manufacture of hazardous materials to destruction of such materials or their negative properties once their useful life is complete. Between those extremes are various methods of hazard reduction, including material reuse, recycling, treatment, stabilization and isolation. Current public policy, voiced in some fashion by nearly every state as well as the federal government, establishes a hierarchy of waste handling options which descend in the following order, from most to least desirable: waste minimization; physical, chemical or biological treatment; incineration; solidification and/or stabilization; and secure landfill.

The policy, much more easily justified than implemented, is clearly extant in Region 10, as the very "pecking order" shown above has been placed in statute by the State of Washington, and exists in the hazardous waste management planning documents of the other three states. All of the Region 10

POLYCHLORINATED BIPHENYLS (PCB)

Polychlorinated biphenyls (PCB) have been used in industry for a variety of purposes since 1929. Primary applications have been as electrical transformer cooling liquids; capacitor dielectric liquids; heat transfer and hydraulic fluids; dye carrier in carbonless copy paper; plasticizer in paints, adhesives and caulking compounds; and filler in investment casting wax.

Most liquid filled transformers are cooled with mineral oil. This oil can present a significant fire hazard in the event of a short circuit within the transformer; therefore, oil-filled transformers are not allowed to be used in hazardous locations such as buildings except when installed in fire resistant concrete vaults. Consequently, most transformers used in such locations have been filled with non-flammable coolant liquids containing PCBs as a major component. The liquids are known by the generic term "askarel" and have been in common use since the 1930's in hazardous transformer applications. Transformers with PCB concentrations greater than 500 ppm are considered to be "PCB transformers".

An even greater number of transformers contain mineral oil with relatively dilute PCBs. Those units were designed to use PCB-free mineral oil, but now contain PCBs because of contamination that occurred in manufacturing or servicing operations. Transformers containing oil contaminated with PCBs at 50-500 ppm are considered to be "PCB-contaminated transformers". The useful life of an undamaged transformer is usually about 40 years. Alternating current capacitors of various sizes have been installed in electrical equipment ranging from large distribution systems to small lighting fixtures (ballast). Nearly all of those units built before 1978 contain PCB liquids as dielectric fluid and most of the units are sealed. Other types of electrical equipment, such as regulators, switches, circuit breakers and cables also contain PCBs. PCB oils have been used in other ways as well, including such "non-contained" applications as sealing, coating and dust control. Long term manufacture, cumulative use and gross environmental distribution established PCBs as a ubiquitous contaminant in the United States by the mid-1970's. That fact, along with the discovery of a spectrum of toxic effects and potential carcinogenicity, prompted the inclusion of PCBs on the list of materials regulated by the Toxic Substances Control Act of 1976. Requirements of that Act and subsequent regulations have the following effects:

1. No further manufacturing of PCBs or distribution in commerce unless exempted by EPA after July 1, 1979.

2. Authorization for use of large PCB capacitors located in restricted-access electrical substations and in restricted-access indoor installations for their useful lives; prohibition of the use of all other large PCB capacitors after October 1, 1988.

3. The use of PCB transformers that pose an exposure risk to food or feed was prohibited on October 1, 1985.

4. The use of network PCB transformers with higher secondary voltages (greater than 460 volts) in or near commercial buildings will be prohibited on October 1, 1990.

state agencies prefer destruction of hazardous wastes or their properties to any attempt to perpetually contain them, but such destruction is not physically possible for some substances, notably the heavy metals. While most wastes can be changed to a non-hazardous state, many of the available processes leave residues which can only be managed by long-term isolation and immobilization.

Most of the generators in the region ship their wastes off-site within 90 days of generation, thus avoiding regulation as a storage facility. The handling of hazardous waste beyond the point of generation is accomplished by only a few organizations at a small number of facilities; that is, the number of generators who store, treat or dispose of waste on-site is quite small, and those who provide those services off-site are even fewer.

Regulated waste handling facilities must provide biennial reports of activities. If those facilities are to continue handling hazardous wastes beyond specified dates, depending on facility type, they need to secure operating permits from EPA or an "authorized" state agency. The biennial reports provide data on the number and nature of treatment, storage and disposal facilities (TSDF's) in the region. Table 8 lists the numbers of facilities in each state which handled hazardous waste in 1985. Eighty-eight facilities were active in Region 10 (Alaska, 5; Idaho, 10; Oregon, 13; Washington, 60). Several of those facilities conducted more than one type of activity, so the columns in Table 8 do not sum to the total number of facilities in each state.

TABLE 8

TREATMENT, STORAGE AND DISPOSAL FACILITIES, REGION 10, 1985

Number of Facilities	AK	ID	OR	WA	REGION 10
Storage					
On-Site	1	7	6	20	34
Off-Site		2	3	9	14
Both	2	1	4	11	18
Subtotal	3	10	13	40	66
Treatment					
On-Site	1	3		24	28
Off-Site			2	4	6
Both				4	4
Subtotal	1	3	2	32	38
Disposal					
On-Site				5	5
Off-Site				2	2
Both	1	1	1		3
Subtotal	1	1	1	7	10
Total TSDF's[1]	5	10	13	60	114

1. Columns do not sum to total number of facilities because some facilities conduct more than one type of activity.

Over half (34) of the storage facilities were generators who stored only their own wastes. Fourteen establishments stored wastes only from others, while 18 of them stored wastes generated both on-site and off-site. Treatment was provided only for on-site generated wastes by 28 of the 38 facilities which treated waste. Only 10 of them accepted wastes from other entities. Similarly, disposal was accomplished exclusively on-site by five generators, while an equal number of facilities disposed of wastes other than their own.

Most of the off-site treatment and disposal facilities are commercial in nature, generally accepting wastes from all sources. No off-site treatment facilities are found in either Alaska or Idaho; no commercial off-site disposal facility exists in either Alaska or Washington, although recycling and treatment operations function in both states, in some cases acting only as "middlemen" for out-of state facilities. One landfill accepted hazardous waste from one generator in Washington in 1985, and the Arco Prudhoe Bay Unit in Alaska accepted hazardous waste from other parties at its injection well until August, 1985.

Two major commercial landfills are operated in the region: Chem-Security Systems, Inc. (CSSI), near Arlington, Oregon; and Envirosafe Services of Idaho, Inc. (ESII), near Grandview, Idaho.

Destination of Region 10 Wastes

The disposition of wastes generated within Region 10 is shown in Table 9, including the amount of waste handled by each method. The reported tonnage of waste handled in each state is higher than the amount reported as generated

TABLE 9

REPORTED DISPOSITION OF HAZARDOUS WASTE GENERATED
IN REGION 10, 1985, TONS

Method of Handling	AK	ID	OR	WA	TOTAL [1,2]
In-State Storage					
Container	112	70	2369	6917	9468
Tank		43	3580	6426	10049
Pile				148,729	148,729
Impoundment	112			6150	6272
Other				9	9
Subtotal	234	113	5949	168,231	174,527
In-State Treatment					
Tank	5	60		354,021	354,086
Impoundment			4022		4022
Thermal				2437	2437
Other		11	379	1927	2317
Subtotal	5	71	4401	358,385	362,862
In-State Disposal					
Injection Well	1111				1111
Landfill		230	7055	39474	46759
Land Appl.				1445	1445
Impoundment				28982	28982
Other				1	1
Subtotal	1111	230	7055	69902	79298
Shipped out of State	790	1810	9097	70094	81791
Total	2140	2224	26502	666,612	697,478

1. Does not include PCB's

2. Includes 316,249T of wastewater which is treated and discharged under NPDES permit, directly or through POTW's.

because: (1) waste from small quantity generators is included, (2) sequential storage, treatment and disposal of the same waste sometimes results in double or triple counting, (3) wastes generated in a prior year, and still in storage at the end of a reporting year are counted in the facility reports, but not in the generator reports, and (4) the delay between the date of shipment from a generator and the date of handling by a facility near the first of a calendar year can cause an imbalance in generator and facility reporting. The methodology of this survey did not allow for reconciling those differences.

Nearly 700,000 tons of waste generated within the region were handled in some fashion during the year. Ninety percent of the waste handling took place in Washington, where wastewater treatment comprised one-half of the regional total. Storage accounted for 175,000 tons of waste--again, mostly in Washington.

In-state management of Alaska wastes was accomplished by storage and deep well injection. Idaho landfilled (in-state) about 230 tons of its waste, approximately one-tenth of the amount generated in that state. Oregon's handling methods for its own wastes were quite evenly balanced among storage (5949 tons), treatment (4401 tons) and disposal by secure landfill (7055 tons).

Import - Export

Possibly the most controversial hazardous waste management issue in any region of the country, other than specific facility siting proposals, is the matter of interstate transport of waste. Region 10 has its share of activity in that regard, as all four of the states export hazardous waste and all except Alaska import substantial quantities for treatment and disposal. The states of the region "trade" wastes not only among themselves, but also with many states outside the region. The import/export matrix is shown in Table 10.

Within the region, Washington exported the most waste (70,128 tons) in 1985, but also imported a large amount because commercial treatment facilities exist there. Washington generators shipped 62,405 tons of regulated waste to Oregon and 2692 tons to Idaho (Figure 8). Over 5000 tons were sent outside of Region 10. Washington imported 5506 tons of waste from Oregon, 443 tons from Idaho and 32 tons from Alaska. The 32 ton figure for Alaska is based on reports from generators in that state; facility reports from Washington show 253 tons of waste from Alaska. Problems related to waste definitions apparently exist and the reporting inconsistencies were not reconciled during this survey. No waste was imported by Washington from outside the region. Thus Washington is a net exporter overall; a net importer with respect to Alaska; a net exporter to Idaho; a net exporter to Oregon; and a net exporter to the states outside the region.

Oregon, due to the presence of a major commercial waste disposal facility, imported a large quantity of waste. By agreement between the facility operator and the Oregon DEQ, wastes are accepted from only certain states outside Region 10 (2760 tons in 1985). Oregon received 62,405 tons of hazardous waste from Washington in 1985, 608 tons from Idaho, and 101 tons from Alaska. Exports included 5506 tons to Washington and 143 tons to Idaho (Figure 9). Nearly 9100 tons were shipped outside the region. Oregon is, therefore, a net importer overall by a factor of six, and a net importer from all three of the other Region 10 states, but is a net exporter to states outside the region.

TABLE 10

IMPORT AND EXPORT OF HAZARDOUS WASTE

REGION 10 STATES, 1985, TONS[1]

	AK	ID	OR	WA	REGION 10
Shipped to:					
Alaska		0	0	0	0
Idaho	16		143	2692	2855
Oregon	101	608		62405	63114
Washington	32	443	5506		5981
Shipped Out of Region 10	641	759	3448	5031	9879
Total Export	790	1810	9097	70128	
Imported from:					
Alaska		16	101	32	
Idaho	0		608	443	
Oregon	0	143		5506	
Washington	0	2692	62405		
Imported from Outside Region 10	0	934	2769	0	3694
Total Import	0	3785	65874	5981	
Net Import	(790)	1975	56777	(64147)	(6185)

1. Does not include PCBs

2. ( ) = negative Value

Figure 8

Export of Hazardous Waste, 1985, Washington

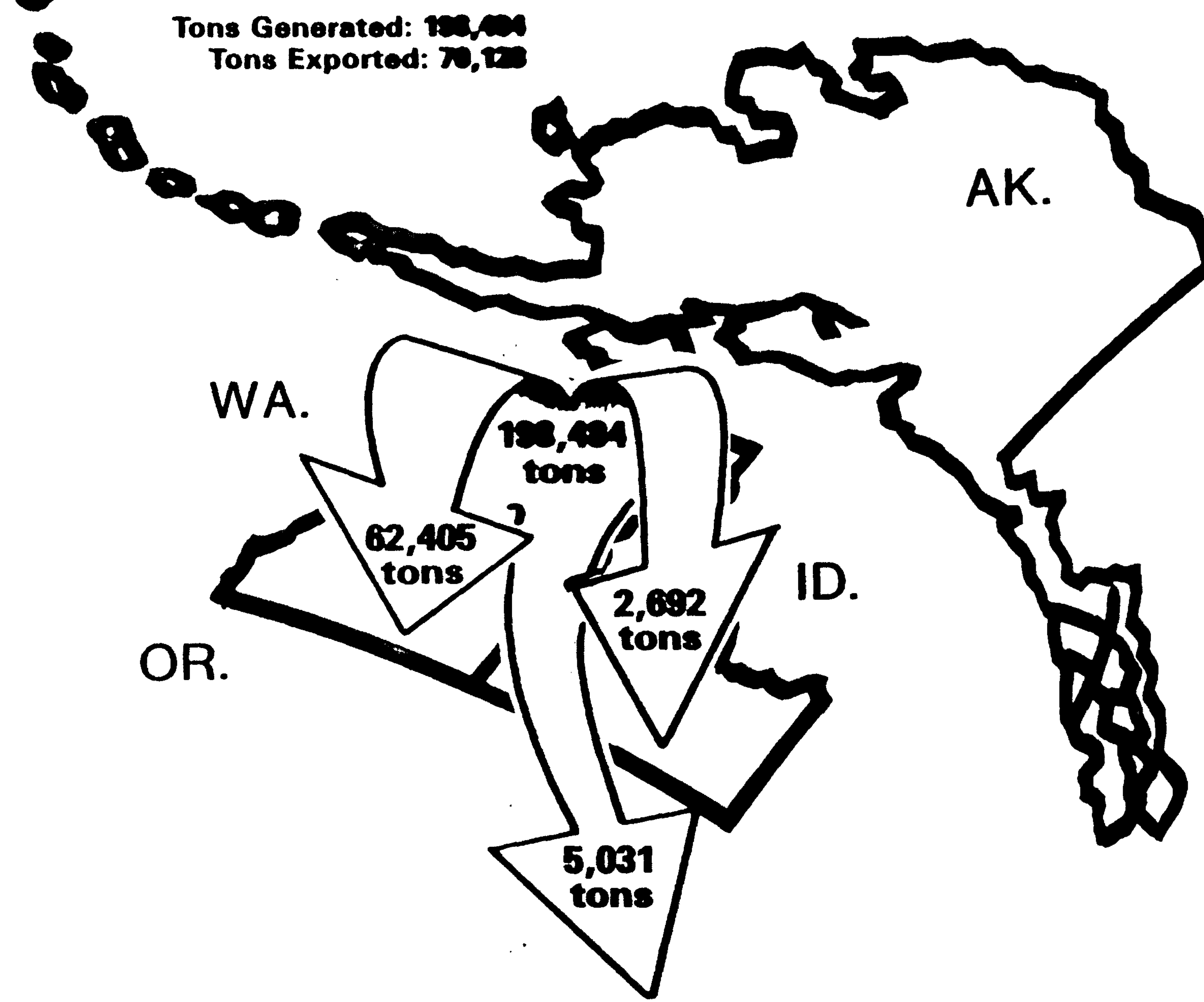


Figure 9
Export of Hazardous Waste, 1985, Oregon

Tons Generated: 26,813
Tons Exported: 9,097

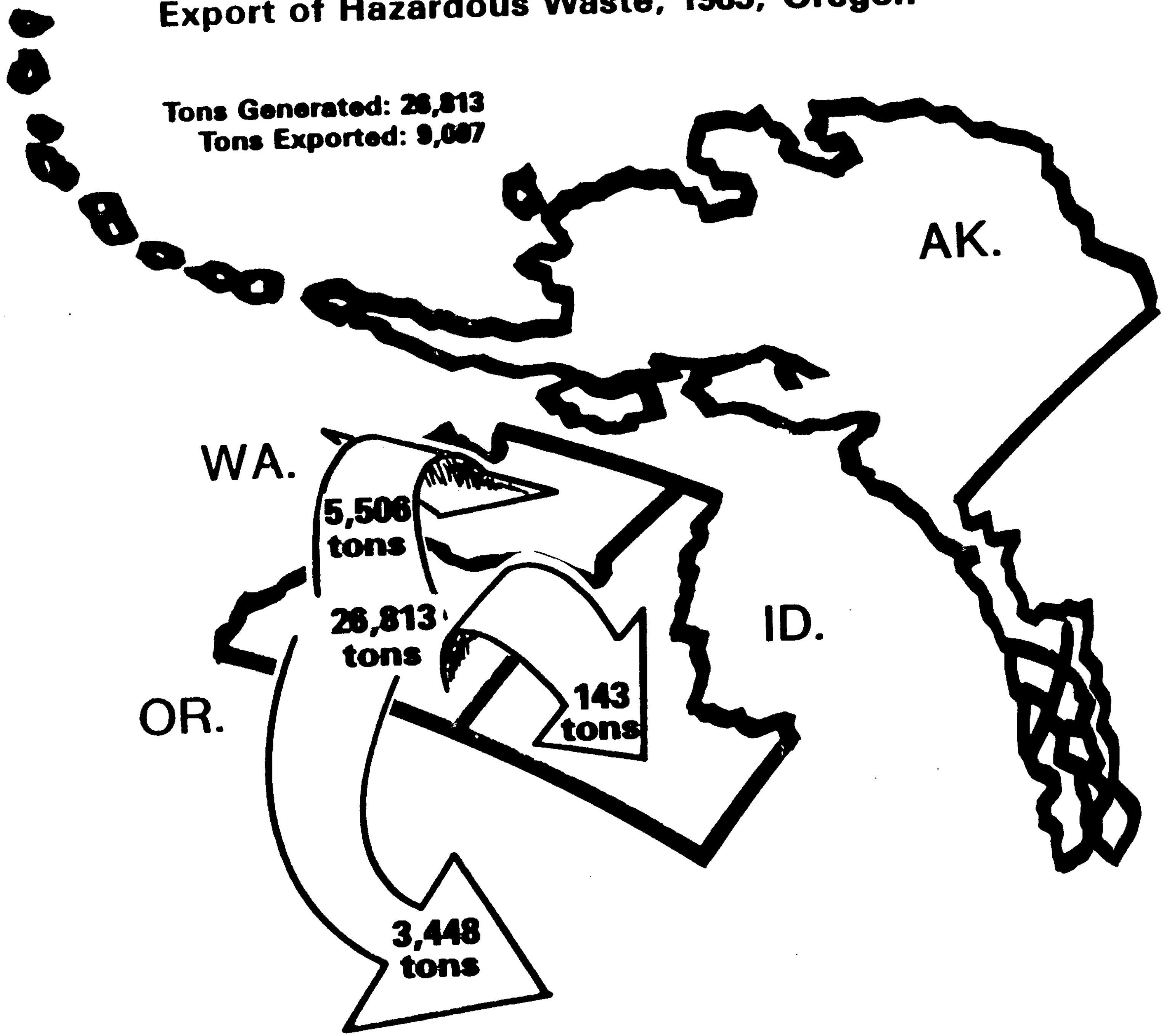


Figure 10

Export of Hazardous Waste, 1985, Idaho

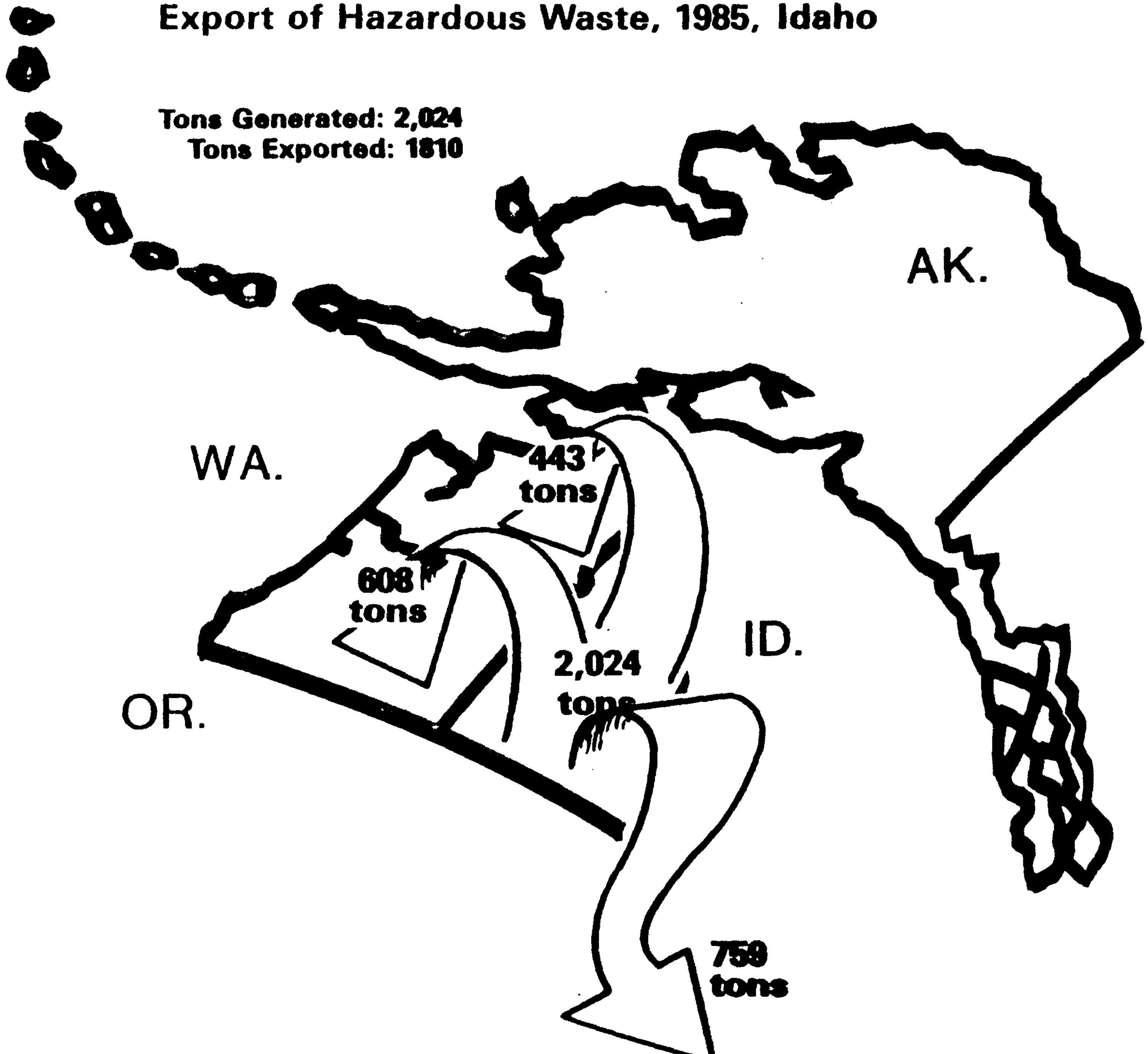
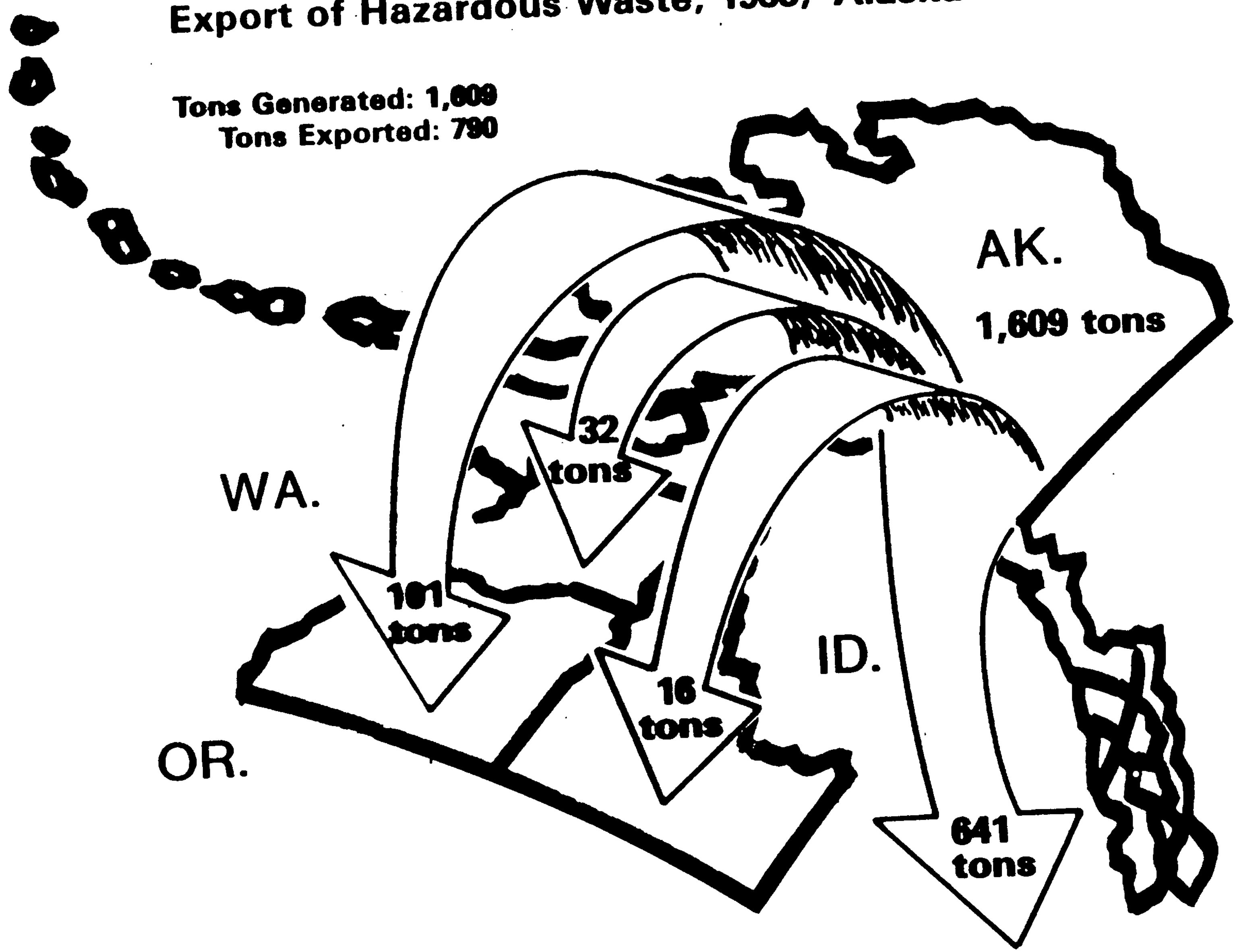


Figure 11

Export of Hazardous Waste, 1985, Alaska



Idaho has a commercial landfill which receives waste from the other Region 10 states and from many states outside the region. In 1985, Idaho imported 2692 tons of hazardous waste from Washington, 143 tons from Oregon and 16 tons from Alaska. Nine hundred thirty-four tons came from outside the region. Exports included 759 tons of waste to states outside the region, 608 tons to Oregon and 443 tons to Washington (Figure 10). Thus, Idaho is a net waste importer overall by a factor of 2; a net importer from Alaska; a net exporter to Oregon; a net importer from Washington; and a net importer with respect to states outside the region.

Since Alaska has no commercial waste disposal facilities, no hazardous wastes were imported there. Alaska shipped 32 tons to Washington, 16 tons to Idaho, and 101 tons to Oregon (Figure 11). Over 640 tons were sent outside the region. The state is, of course, a net exporter to all of the other Region 10 states.

The 10,000 tons of waste exported from the region comprised 4.3% of the total hazardous waste generated, exclusive of NPDES wastewaters. Imports to the region amounted to 3694 tons. Region 10 is, then, a net exporter of waste to the rest of the country. The materials sent out of the region for treatment and disposal were distinctive in that they tended to be organic, usually liquid, and represented waste groups which require very specialized handling (particularly: product recycling, re-refining and high efficiency incineration).

Hazardous wastes imported to the region were broad spectrum and were not voluminous compared to in-region generated wastes (1.6%); however, since some of the RCRA-regulated wastes from outside the region were destined for Idaho, their relationship to wastes generated in that state was markedly different. Non-Region 10 waste sent to Idaho was in the same order of magnitude as waste generated there, and as will be seen later in this report, that volume was eclipsed by the quantity of imported PCB waste.

When imports from all sources are viewed in relation to waste generated in-state, Idaho and Oregon receive the "lion's share". Idaho imports twice as much as it generates, and Oregon gets four times its "share". Note, however, that Idaho exports most of the waste that it generates.

Waste Handling - All Sources

Table 11 details the handling of hazardous waste (exclusive of wastewater) from all sources in 1985 according to location of the activities. In this portrayal, however, the Washington NPDES-regulated wastewaters were not included. "Tank" treatment refers to a variety of methods, whether physical, biolological or chemical, in which the treatment takes place within fabricated, confined facilities. "Impoundment", as it applies to both storage and treatment, means an earthen facility, below or above ground level.

Well over one-half of the storage occurred on the site of generation (Figure 12). The on-site storage was nearly all in the form of waste piles, and containerized wastes were typically stored at off-site

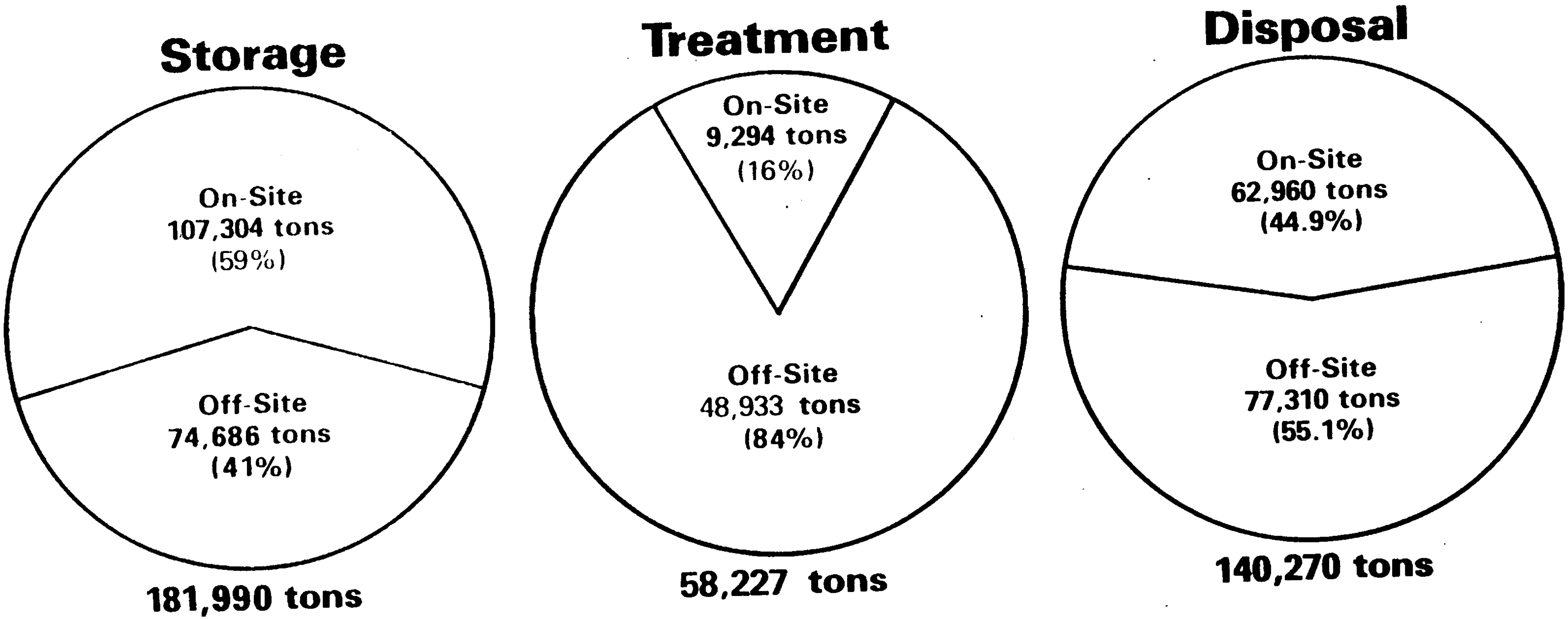
TABLE 11

REPORTED HANDLING OF HAZARDOUS WASTE FROM ALL SOURCES AT REGION 10 FACILITIES, 1985, TONS [1,2]

Method of Handling		AK	ID	OR	WA	TOTAL
Storage				[3]		
Container	on-site	75	137	1400	2753	4365
	off-site	37	1	1500	5474	7012
Tank	on-site		60	2300	1853	4213
	off-site		10	1400	8530	9940
Pile	on-site				91,729	91,729
	off-site				57,000	57,000
Impoundment	on-site	122		725	6150	6997
	off-site			725		725
Other	on-site					
	off-site				9	9
Subtotal	on-site	197	197	4425	102,485	107,304
	off-site	37	11	3625	71,013	74,686
Treatment						
Tank	on-site	5	60		4854	4919
	off-site				31,806	31,806
Impoundment	on-site					
	off-site			16,500		16,500
Thermal	on-site				2437	2437
	offsite					
Other	on-site		11		1927	1938
	off-site			627		627
Subtotal	on-site	5	71		9218	9294
	off-site			17,127	31,806	48,933
Disposal						
Injection Well	on-site	496				496
	off-site	615				615
Landfill	on-site			11	32,026	32,037
	off-site		4740	65,200	7448	76,695
Land Appli.	on-site				1445	1445
	off-site					
Impoundment	on-site				28,982	28,982
	off-site					
Subtotal	on-site	496		11	62,453	62,960
	off-site	615	4047	65,200	7448	77,310
Total	on-site	698	268	4436	174,156	179,558
	off-site	652	4058	85,952	110,267	200,929
Grand Total		1350	4326	90,388	284,423	380,487

1. Does not include NPDES waste waters or PCB's over 50ppm
2. Includes imports
3. On-site, off-site distribution estimated

Figure 12
Location of Hazardous Waste Management Facilities, Region 10, 1985



facilities while awaiting final disposition. Eight-four percent of the waste treatment was accomplished at off-site locations, all in Oregon and Washington. On-site treatment occurred to a relatively minor extent in all of the states except Oregon, which reported none. Fifty-five percent of the final disposal in the region was done at off-site facilities, primarily in Oregon. Washington industries landfilled a large quantity of material on-site (32,036 tons).

Alaska

The primary handling method practiced in Alaska was injection into a deep aquifer at one North Slope disposal site. The well was used to dispose of large volumes of non-hazardous oil production and process waters, and received hazardous waste from the Prudhoe Bay Unit at which the well is located. Hazardous waste from other parties was taken until August, 1985. Over half (615 tons) of the 1111 tons of hazardous waste reported to be disposed of through the well came from off-site generators. Those off-site generators and several others also sent larger volumes of wastes not reported by the generators as hazardous; as previously mentioned, it is likely that about 4600 tons of those wastes were, in fact, hazardous by definition.

Approximately 15% of the reported wastes were stored for at least 90 days, mostly on-site. Virtually no treatment of waste occurred in the state.

Idaho

Two hundred eight tons of waste were stored in Idaho during 1985. A small quantity of material (70 tons) was treated on-site. The presence of a commercial landfill attracted 4047 tons of hazardous wastes for disposal (all off-site).

Oregon

Storage facilities in Oregon handled over 8000 tons of hazardous waste in 1985, about half on-site and half off-site. Treatment of corrosives by impoundment (16,500 tons) was accomplished at the Arlington facility (all off-site). The same facility landfilled approximately 65,000 tons of hazardous waste (exclusive of PCB waste) off-site plus a small amount generated on its own premises. Slightly less than 62,000 tons of the total waste handled at the Arlington site originated in Washington.

Washington

Nearly 329,000 tons of waste were handled by various facilities in Washington. About 208,000 tons were stored, three-fourths in waste piles (half on-site). Over 50,000 tons of waste were stored in containers and tanks, mostly off-site. "Tank" treatment was applied to about 46,000 tons, while 12,000 tons were treated by other means. Disposal, which totaled almost 70,000 tons, was done mostly on-site (89%). More than 30,000 tons of waste were impounded.

Current Methods

The most common methods of management employed in the region for toxic metal solutions and sludges were chemical precipitation, filtration and land disposal. Corrosives were handled primarily by neutralization and landfill. Toxic anion solutions have usually been dealt with by chemical oxidation (cyanides) and by landfill (most other anions). Inorganic residuals and sludges were all landfilled or placed in long-term storage in waste piles. Discarded commercial chemical products were landfilled.

Some non-halogenated solvents were sent to fuel blenders; others were evaporated, distilled, reprocessed or landfilled. Halogenated solvents were recycled by distillation and condensation or disposed of by evaporation and landfill. Reactive wastes were usually landfilled or treated thermally. Paint residuals were often landfilled, although some corrosive paint wastes were neutralized, halogenated paint wastes were distilled for recovery, and the metals were precipitated from some others. Pesticides and remedial action cleanup wastes were mostly landfilled.

5. All radial PCB transformers and lower secondary voltage network PCB transformers in use in or near commercial buildings must be equipped with electrical protection to avoid transformer failure caused by high current faults.

6. All radial PCB transformers with higher secondary voltages (above 480 volts) in use in or near commercial buildings must be equipped with protection to avoid failure caused by low current faults.

Transformers and capacitors occasionally fail and leak, sometimes causing contamination of equipment and soil. On an annual basis, about 3% of the PCB transformers can be expected to leak or will be associated with a spill. Approximately 2% of large capacitors will lose fluid each year, usually by fairly violent rupture, thus more widely scattering the contents than do transformers. Proposed TSCA regulations incorporate requirements for cleaning up areas contaminated by spill of materials containing 50 ppm or greater PCBs. In the past, various regional policies have required cleanup to levels in the 25-50 ppm range in contaminated soil. National standards were published in April, 1987 for cleanup of recently contaminated materials. Other specific standards will be determined on a case-by-case basis.

The RCRA amendments of 1984 and EPA regulations establish disposal rules pertaining to PCB wastes. Disposal of liquid wastes with a PCB concentration greater than 500 ppm is allowed only in an incinerator approved by EPA or by an approved alternative treatment method providing an equivalant reduction. Liquid wastes containing PCBs with concentrations of 50-500 ppm may be disposed of by any of three methods:

(1) EPA approved incinerator, (2) EPA-approved high-efficiency industrial boiler, (3) EPA-approved alternative treatment method achieving a level of performance equivalent to an approved incinerator or boiler.

Transformer carcasses which have been drained and flushed may be landfilled. Large capacitors are usually shipped intact to an incincerator. Very small non-leaking capacitors (three pounds fluid or less) may be placed in municipal landfills. Waste materials contaminated at less than 50 ppm PCBs are not controlled by TSCA, but are regulated as a hazardous waste by the State of Washington when generated at the rate of 400 pounds per month or batch.

Approximately 121,000 (askarel) PCB transformers are currently in use in the United States; there are about 20 million mineral oil transformers of which perhaps 7.5 million contain 50-500 ppm PCBs. Just less than 3 million large PCB capacitors are still in use. When those national estimates are disaggregated on the basis of electrical energy use in each northwest state, Region 10 appears to have about 7000 PCB transformers, over 400,000 contaminated mineral oil transformers and 180,000 large PCB capacitors. Based on population rather than electrical energy use, those regional estimates would become 4500; 280,000; and 110,000, respectively.

PCB Waste Generation

Based on national data, Region 10 would be expected to have had about 7000 tons of askarel is use in 1985. PCB waste ..l generation (greater than 500 ppm) would have been approximately 850 tons in 1985, if the region produced an equal percapita share of the national total. Obviously, crude disaggregation of national data is, at best, an imprecise means of estimating current and future PCB waste generation, but it is a checkpoint for other methods.

Electrical Utilities

The primary PCB waste source in the region is the electrical utility industry. Direct information regarding that source was secured through a mail survey of Region 10 utilities conducted in the fashion described in the methodology section of this report. The companies were asked to report the quantities of PCB oils, capacitors, transformers, and soils and other solids which were disposed of in the most recent year of record. Estimates were also requested of the percentage of PCB materials already removed from their systems, the number of years remaining in their PCB disposal programs, the probable peak year for waste disposal and the population served by the utility. They were also asked for an opinion regarding the need for PCB disposal facilities in the northwest region.

Responses were received from 58 utilities of wide variety in size which serve a total population of approximately three million (1/3 of total population). The composite report of annual PCB waste generation and disposal is presented in Table 12 (data relate to 1985 or 1986). One hundred seventy-three tons of waste PCB oils over 500 ppm were handled, along with 524 tons of waste oil with 50-500 ppm PCBs and 175 tons of oils with less than 50 ppm PCBs.

TABLE 12

ANNUAL PCB WASTE GENERATION AND DISPOSAL[1]
REPORTED BY 58 ELECTRICAL UTILITIES[2], REGION 10, 1985/1986

	Tons		
	Over 500ppm	50-500ppm	Less than 50ppm
Oil			
Incineration	143	415	
Chemical Treatment	30	109	7
Landfill			51
Fuel blenders			117
Soils, Debris, Misc. Equipment			
Incineration	3	5	
Chemical Treatment		0.2	
Landfill	77	129	
Capacitors			
Incineration	309[3]	5	
Transformer Carcasses			
Landfill	265	446	

1. All incineration outside Region 10; some landfill outside Region 10.

2. Serving a total population of approximately 3 million; population of region is about 8.8 million

3. Including oil; weight of oil approximately 30% of total

Eighty percent of the high level PCB oil was incinerated (out of region) and the remainder was chemically treated. About 80% of the 50-500 ppm oil was also shipped for incineration, while 20% was chemically dechlorinated. The largest portion of the Washington-regulated waste (less than 50 ppm PCB oils) was sent to fuel blenders; some was landfilled.

Three hundred fourteen tons of capacitors were shipped for incineration. Contaminated soil was landfilled (206 tons) or incinerated (8 tons). Transformer carcasses totaled 711 tons; all were ultimately landfilled or recycled. The survey data were extrapolated to the entire region on the basis of population served, which is highly speculative. By this method, each value in Table 12 is tripled.

The questionaires were divided into three groups according to size of population served to facilitate analysis of the responses regarding furthur disposal patterns (population greater than 100,000 = large; 20,000 - 99,999 = medium; less than 20,000 =small). Through these groupings, weighted averages of estimated percentage of PCB waste disposal completion, remaining years of disposal program and peak future year for waste disposal could be computed. Weighted averages were determined because the waste disposal programs of the large utilities will establish and dominate the actual pattern for the region.

The results are reported in Table 13. The indication is that the waste PCB disposal programs of the electrical utilities are just under one-half completed (individual programs ranging from 0 - 99% complete); an average of 11.4 years of PCB disposal remain (range = 0-30 years); and the peak disposal

TABLE 13

ESTIMATED PCB WASTE GENERATION PATTERN
58 ELECTRICAL UTILITIES, REGION 10

Number of Companies	% Disposal Complete (Ave.)(Range)	Years of Disposal Remaining (Ave.)(Range)	Peak Year for Disposal (Ave.)(Range)
		Large Companies	
8	51 (15-97)	13 (4-20)	1988 (1987-1991)
		Medium Companies	
16	34 (5-100)	11 (0-30)	1989 (1987-1990)
		Small Companies	
34	54 (0-99)	7 (1-25)	1988 (1987-1990)
		Weighted Averages	
	47 (0-100)	11.4 (0-30)	1988

TABLE 14

ESTIMATED PCB WASTE GENERATION, REGION 10, 1985
(ALL SOURCES)

	Tons Over 500 ppm	Tons 50-500 ppm
Transformer Oil	450 - 550	1200 - 1600
Soils, debris Misc. Equipment	2000 - 3000	
Capacitors[1] with oil	800 - 1200	10 - 20
Transformer Carcasses	1000 - 2000	1000 - 2000

1. Oil approximately 30% of total weight

year will be 1988. Informal questioning of utility representatives resulted in the conclusion that the rate of PCB waste generation increased markedly from 1985 to 1987, will remain steady until about 1991, and will then decline (rapidly for high-level PCB oils, and slowly for low concentration oils). The timing of the peak is determined by regulatory requirements phasing out non-substation capacitors by 1988. Under current regulations, the electrical protection requirement for grid network askarel transformers is assumed to be tantamount to a phaseout by 1990.

Thirty-nine of the 58 respondents in the utility survey commented regarding the need for PCB management facilities in the northwest. Twenty-eight of them felt that an incinerator of some sort should be made available within Region 10. A facility sited in Alaska was suggested by four companies and three proposed mobile incineration. Two respondents thought that the utility industry (association?) should operate its own disposal facility. Seven companies wanted to have dechlorination facilities available in the northwest, and three people recommended facilities specifically designed to handle wastes with PCBs of less than 50 ppm. Two responses related to a need for more recycling and scrapping operations geared to handling PCB-contaminated equipment.

Other Industry

Manufacturing industries use certain electrical equipment which does not belong to the utility companies. Waste PCBs from those sources are difficult to determine. Discussions with industrial representatives and review of national data and limited regional records place the generation rate at about one-third of that produced by utilities (perhaps one-half or more for contaminated soils).

Military Installations

The Department of Defense manages PCB waste from active military sites through various contracts issued by the Defense Reutilization and Marketing Service to operators of commercial disposal facilities. The Service was requested to provide data pertaining to PCB waste generation and disposal in Region 10 in 1985. Wastes included transformers, capacitors, liquids, soil and debris, all of which totaled 700 tons. Nearly all of the waste came from Alaska and Washington. About 450 tons of PCB waste were contaminated soils from active Alaskan military facilities. Over 600 tons of waste were shipped outside of Region 10 for disposal. Idaho disposal facilities received all but a small fraction of the remainder of the waste from DRMS.

DRMS reports that the PCB waste materials from Alaska will increase each year until 1991, and then decrease substantially. The wastes from Washington and Idaho active military sites have already peaked and are now decreasing each year.

The Corps of Engineers operates a program to clean up inactive and abandoned sites in federal ownership in Alaska. That program, funded through the Defense Environmental Restoration Account, deals with hazardous materials of all kinds, including PCB wastes. Over 350 sites have been identified for possible cleanup. Many mining operations and World War II communications facilities operated on-site power generators; their equipment contained substantial quantities of PCB oil, some of which still exists within intact electrical equipment and some of which was spilled on the soil. In many cases, other hazardous materials are present as well.

While a reliable determination of PCB waste generation for any particular year is not possible, EPA staff estimate that the total waste production from this program could well surpass 500 tons per year, much of which will be PCB - contaminated soil, equipment and oil. The amount will depend primarily on the cleanup standards ultimately imposed. A 50% difference in the cleanup standard (PCB concentration allowed to remain) could produce a tenfold difference in the amount of soil to be treated at a site.

<u>Regional PCB Waste Estimation</u>

Table 14 presents a synthesis of the PCB waste generation pattern from all sources in Region 10 in 1985. The following estimates were made: Total PCB oil over 500 ppm, 450-550 tons; PCB-contaminated mineral oil, 1200-1600 tons; soil and miscellaneous materials, 2000-3000 tons; capacitors with oil, 800-1200 tons; and transformer carcasses, 2000-4000 tons. The potential error in the original extrapolation is quite high, but the ranges presented should be reasonably accurate.

A projection of PCB oil waste generation from all sources was made, based on the foregoing information. As shown in Figure 13, the hypothetical generation pattern for high concentration oils includes a general peak around 1988 followed by a precipitous decline near 1990, reflecting the likely removal of most grid network askarel transformers and certain large capacitors. In contrast, the low concentration oils will remain in the waste stream for up to 30 years, although most will be gone by the end of the century.

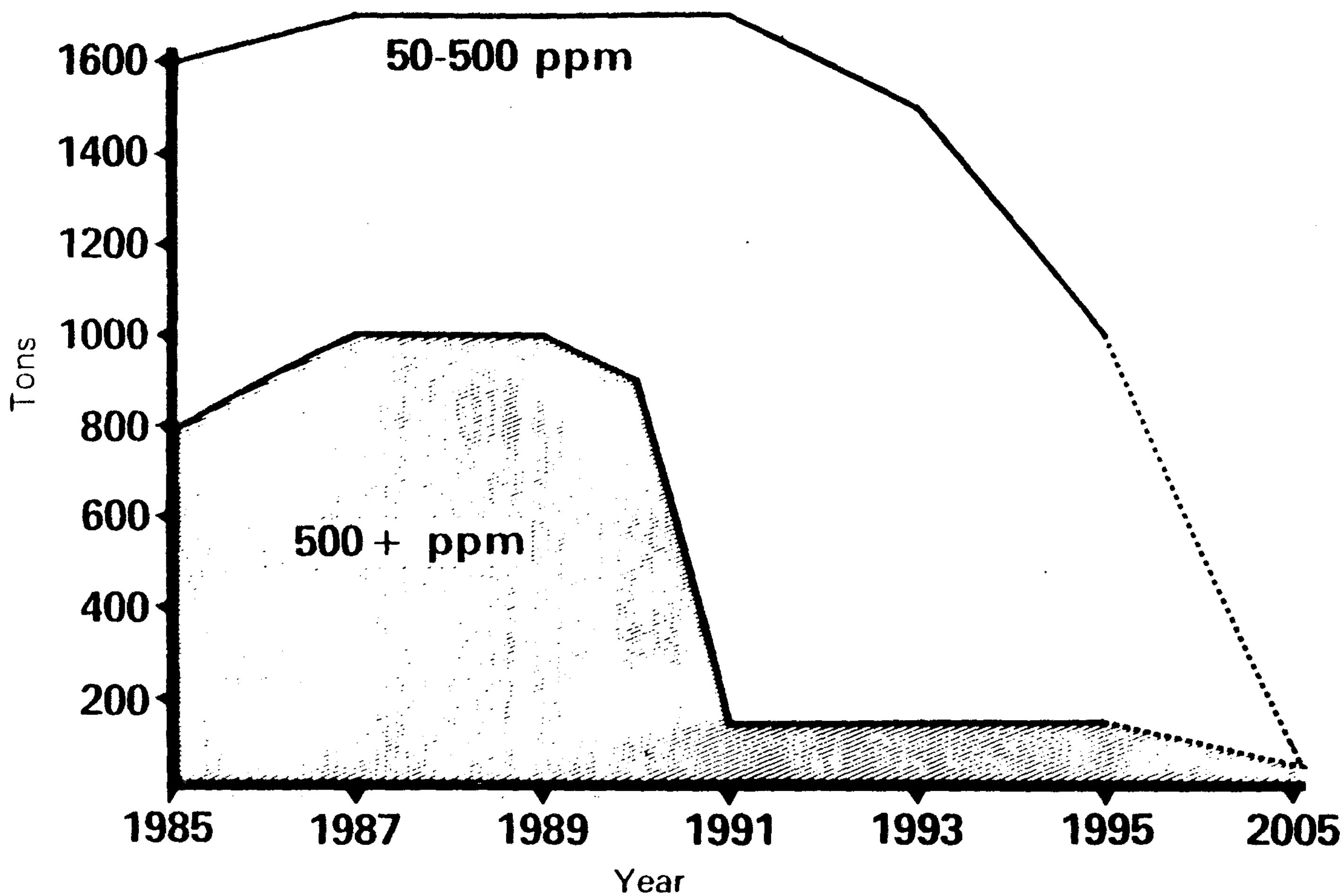


Figure 13

Hypothetical PCB Oil Waste Generation, Region 10

PCB waste disposal volumes within Region 10 are a matter of record. Total disposal (all by landfill) in the region in 1985 reached approximately 17,000 tons, over 13,000 tons in Idaho. Since 10,000 tons of that waste came from outside the region, the rate of disposal bore no relationship to the Region 10 waste generation.

PROJECTED HAZARDOUS WASTE GENERATION

Hazardous waste generation in future years will be determined by a broad range of factors. Among the most apparent factors expected to affect the volume of waste produced are economic growth, regulatory changes, implementation of waste minimization practices, and remedial action programs (CERCLA; RCRA corrective actions; state-imposed or assisted projects; leaking underground storage tanks; military programs).

Economic Growth

Basic economic analysis is beyond the scope of this survey. Moreover, prediction of economic growth has been shown to be an imprecise practice in past years even when attempted by experts armed with industry-specific data. It will suffice for the purpose of this exercise to borrow an annual growth rate value from the projections offered by the Northwest Power Planning Council in its 1986 electric power plan. At the risk of oversimplification, one might reduce those projections to a low forecast of 0.2% per year growth in manufacturing and services, a high forecast of 2.7% growth and a mid-level growth forecast of 1.6%. Even if one of those values ultimately describes the actual growth of the overall economy, there will be, of course, quite different rates of growth (or decline) for each economic sector.

It is fairly safe to assume, however, that substantial growth will occur over a period as long as that in question here (20 years) in most of the sectors which produce the bulk of the hazardous waste in Region 10. Possessing no basis for refinement, the midlevel estimate of 1.6% growth per year will therefore be applied across the board beyond 1986 in calculating future hazardous waste generation as it is affected by the economy.

The economic growth rate will be assumed to be the same in all four states, although Alaska may have the greatest potential for growth beyond the 1985 base year because the oil production industry had already declined substantially by then; it will very likely recover to some degree. The projected effects of economic growth are shown in Table 15 along with other factors affecting waste generation.

Waste Minimization

"Waste minimization" is that set of practices which decreases the volume or toxicity of wastes and reduces the need for treatment and disposal of that waste. Those practices include waste exchange, recycling, reuse and reduction. "Waste reduction" refers to the more limited process of avoiding the production of waste through in-plant practices. The distinction is important only for the purpose of improving communications and determining compliance with RCRA.

Congress established a policy through the RCRA amendments to the effect that where feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. The RCRA regulations require that waste generators report their waste minimization practices and certify that those practices produce the best public health result economically attainable. Actually, the regulations seem to require true waste reduction relative to product output level. They also establish those activities as the first priority in dealing with the hazardous waste problem.

TABLE 15

ESTIMATED EFFECTS OF VARIABLE FACTORS ON FUTURE
HAZARDOUS WASTE GENERATION - REGION 10

1985 Base 240,000 Tons[1]	Increase (Decrease) From Prior Listed Year (Tons)							
	1986	1987	1988	1989	1990	1995	2000	2005
Cleanup Waste (Including PCB)	2000[2]	50,000	(25,000)	0	0	0	(20,000)	0
Economic Growth	3800	3900	4000	4100	4200	25,000	30,000	35,000
Waste Reduction	(7200)	(7000)	(6800)	(6600)	(6400)	(30,000)	(10,000)	(9000)
PCB Waste[3] (Electric Utilities)	4000[3]	2500	0	0	(500)	(3500)	(2000)	(1000)
Net Change	2600	49,400	(27,800)	(2500)	(2700)	(8500)	(2000)	25000

1. Includes small quantity generator waste
2. PCB waste not in base; 1985 base tonnage added to 1986 factor
3. Not in base; 1985 base tonnage added to 1986 factor; oil and transformer carcasses only

In practice, however, waste reduction has been clearly subordinated to more traditional "end of pipe" treatment and disposal techniques, due to several notable disincentives: lack of capital, unfamiliar methods, lack of information, technical limits of process, product quality concerns, and the need to revise environmental permits when waste streams are rechanneled. Nevertheless, strong incentives for waste reduction will probably eventually prevail, such as the increased cost of waste management, TSDF siting difficulties, permitting burdens and corrective action requirements, financial liability of hazardous waste generators, shortages of liability insurance, and public perception and pressure.

Waste reduction techniques for manufacturing plants fall into a few basic categories: (1) product substitution; that is, the manufacturers can choose to develop a different product which has the same practical function as a current product but requires no hazardous raw materials, (2) raw material substitution in the production of the same product, (3) product reformulation, so that less of a hazardous component is used, (4) spill control in manufacturing plants, (5) optimization of process controls (timing, measuring, automation, computerization), (6) process redesign or modification, such as change in equipment to allow reuse of materials or in-line recycling, and (7) industrial good housekeeping, to stop waste and avoid cross-contamination of materials.

The technological means to reduce waste are part and parcel of each production process itself. In view of the multitude of physical plants, no two of which are alike, and the current dearth of comprehensive data, an accurate forecast is virtually impossible. However, anecdotal information indicates that large waste reductions from most sources are technically and economically feasible. Such evidence has led the Minnesota Waste Management Board to conclude that hazardous waste produced in that state can be reduced by about 50% relative to 1984 by the year 2000. Missouri has estimated actual reduction at four percent in 1987. New Jersey expects a 12% reduction over a six year period, relative to production. A 16% reduction was forecast in New York for 1988 alone, based on a study of 34 waste types, 24 of which would experience no reduction at all.

Existing literature reviewed by the U.S. Congress Office of Technology Assessment revealed that in 314 case studies of actual waste reduction programs, 110 sources used in-process recycling, 30 used plant operation changes, 96 used altered process technology, 19 changed process inputs and three changed the end product. Fifty-six also added new management practices for the remaining wastes.

The EPA Office of Solid Waste has estimated potential nationwide reduction potential for 22 industrial categories. Possible reduction percentages for some of those industries of particular interest in Region 10 are;

Electroplating (20-48%)
Metal finishing (18-33%)
Paint manufacturing (18-33%)
Petroleum products (12-30%)
Printed circuit boards (18-48%)
Wood processing (13-40%)
Metal parts cleaning (30-48%)
Paint application (28-43%)

Some of the industries listed above have already reduced waste streams by as much as 75%; the potential reduction figures shown would apply to the amount remaining at this time.

No rigorous analysis of the yet unrealized waste reduction potential in Region 10 has been attempted by anyone. Such information will not come easily under any circumstances. Industry is free with general information about past success, but not about certain methods. Very often, technology is either not transferable or is considered proprietary because it involves production processes. Moreover, recognition of a high potential for waste reduction is thought to build a stronger case for government-imposed quotas, an eventuality considered by all industries to be unfair and impractical.

Most northwest waste generators express optimism for success of voluntary programs. Informal contacts with industrial representatives made by the Oregon DEQ have revealed a consensus that substantial waste reduction has already occurred in that state, but that much more is possible. In particular, it was suggested that the volume of solvent-contaminated materials (mostly aqueous solutions) can be economically reduced by up to 80%. The electronics and transportation equipment industries seem to be doing quite well in implementing programs. While a high potential for waste reduction is generally acknowledged, a comprehensive industry-specific analysis is not available. Certain reduction and recycling practices are likely to be most applicable to various waste groups, however, and some of those practices are listed in Table 16 along with disposal options in the following section of this report.

When projecting future waste management facility needs, the pertinent question is not how much reduction can be realized, but rather, how much will be realized? Neither the federal government nor the states of Region 10 have adopted clear and aggressive programs to secure waste reduction, but several specific policy options have been identified. Assuming that some of those are placed into action soon, the results should at least approximate the predicted national norm. Thus, for the purpose of this analysis, an average value gleaned from state and federal agency estimates will be used. That figure seems to fall somewhere between 30% and 50% reduction over the next 20 years, the largest part of which should occur in the first 10 years. Therefore, when calculating the effect of waste reduction on the future Region 10 waste generation pattern, three percent per year for ten years followed by two percent per year for the next ten years is assumed to be a rational scenario (Table 15).

Remedial Action Programs

Future remedial action projects will produce unknown quantities of formally designated hazardous waste and other materials which will be managed as hazardous waste. Such projects will respond to a variety of occurrences and programs ranging from incidental transportation-related hazardous material spills to the complex national "superfund" effort directed toward past pollution problems. Other projects will result from the independent programs of industries and other private landowners, from RCRA compliance actions, and from cleanups at sites in federal ownership. State regulatory and financial assistance programs will spawn still more cleanups.

The specific nature and volume of the future composite waste stream from those projects is yet to be determined. Each site will require special study and remedial action. The regulatory programs are essentially in their infancy. Some general conclusions can be drawn, though, about the potential need for off-site handling of hazardous wastes in Region 10 relative to past activity levels.

Cleanup projects overseen by federal and state agencies in 1984 produced 45,000-50,000 tons of wastes which were taken to approved hazardous waste disposal facilities. The bulk of that year's cleanup materials (about 42,000 tons) came from one project in Washington (arsenic-contaminated soils, etc.). In 1985, off-site disposal of waste from formally regulated cleanup projects fell in the range of only 2000-3000 tons. No estimate is available for 1986. The off-site disposal of such materials in 1987 is expected to be very high again, largely due to the activation of major projects in Washington, viz., soil removal at the Western Processing superfund site (possibly 50,000 tons) and removal of demolition material from one of the Commencement Bay sites. It can be readily seen that annual waste generation from cleanup projects is highly dynamic. The "CERCLIS list" includes over 1000 sites in Region 10 which are to be studied to some degree regarding possible remedial action. Sixty-five percent of those sites are known to have toxic substances present. Heavy metals have been observed at 34% of the sites and are alleged to be present at another 5% of sites. Organics are known or suspected at 25% of the sites; 21% may have oily wastes, 21% probably have solvents, and PCBs are known to exist at 10% of the sites (30% in Alaska). Liquids are present at over 60% of the sites, solids at about one-half of the sites, and sludges at approximately one-third. Contaminated soil could be a problem at more than 40% of the sites.

Studies of candidate sites, to date, have resulted in the placement of only 27 sites on the National Priority List. Eleven more sites have been formally proposed for inclusion. Twenty-eight of the sites are in Washington, six in Oregon, four in Idaho, and none in Alaska. The sites range from 0.5 to 15,000 acres in size; however, with the exception of the two Commencement Bay sites in Washington (each 15,000 acres), the Bunker Hill site in Idaho (13,400 acres) and the proposed Ault Field site in Washington (2075 acres), none is larger than 455 acres. In most cases, the seriously contaminated areas are much smaller than the site boundaries would suggest.

Schedules for studying each NPL site will depend on funding priorities and many other factors. Formal investigation periods are typically two years long and none of those pertaining to large projects is yet complete, although some remedial actions have taken place. Actual cleanup of the current NPL sites will likely be staggered throughout the next decade and some years beyond. In very general terms, it appears that the actual cleanup phase of the superfund projects in Region 10 will center around the mid-1990's. Waste disposal should accelerate from 1989 to about 1995 and then reduce substantially.

The types of hazardous materials present on the sites represent many of the RCRA waste categories, but seem to be dominated (in volume) by toxic inorganic substances. Some such materials will probably be stabilized in some fashion and remain on-site, especially so for projects which will deal mostly with dry heavy metals. Other materials, particularly the toxic organics, will be treated on-site or taken to approved off-site TSDFs. Current EPA policy regarding CERCLA wastes requires that all such materials taken off-site, whether classified as hazardous wastes or not, must be handled at RCRA or TSCA-approved facilities which are in compliance with regulations.

No estimate of waste to be produced from RCRA facility compliance actions is possible, but those sources will probably increase for a few years. Cleanup projects at active non-military federal facilities (Hanford, INEL, etc.) have not been clearly described either, but several hundred small sites might need attention. Cleanup wastes from active military sites in the region will increase each year until about 1991 and then decrease quickly (the 1991 level may be about twice the 500 tons produced in 1985). Abandoned and inactive federal sites could yield over 1000 tons per year for at least 10 years, mostly in Alaska.

A specific federal program is being implemented to deal with leaking underground storage tanks. Most of the tanks in question contain petroleum products, but other materials are also involved. Ultimately, tank owners will be required to upgrade their equipment and, in the meantime, responsible parties must clean up spills. The inventory of tanks shows 47,000 in Washington, 27,000 in Oregon, 10,000 in Idaho and 7000 in Alaska. One-quarter or more of those tanks can be expected to be leaking by 1990. Little waste from spill cleanups is expected to reach RCRA TSDFs. Two primary reasons for that conclusion are suggested by regulatory personnel. One is that the standard practice for handling contaminated soil is to expose it to the atmosphere, evaporate the volatile materials, and return the soil to its original place (this process might violate RCRA rules if certain toxic residuals are left in high concentration). The other factor relates to the normal practices for treating contaminated groundwater. Spillage of large amounts of liquid, such as the Curtis Road site in Boise, Idaho (over 2,000,000 gallons of gasoline) is captured, pumped and reprocessed as product; however, some spills might result in a small amount of liquid or solid waste disposal.

Estimation of waste types and volumes and prediction of waste management methods to be selected for CERCLA projects are possible for only a few sites at this time, according to EPA site managers, and no purpose would be served by detailing those here. Discussions with those site managers and others lead to the conclusion that the annual volume of materials from CERCLA and non-CERCLA sites which will be taken to approved TSDFs will not often exceed the amount reported in 1984; in fact, far less than that amount will be generated in some years.

The average rate of potential landfill disposal will probably fall near the center of the broad range bounded by the reported values for 1984 and 1985 (from 2000 to 50,000 tons). For the purpose of estimating future commercial landfill needs for cleanup wastes, a rough median value from those extremes was arbitrarily chosen as an annual increment for off-site disposal until 1995 (25,000 tons per year)even though a general increase is actually expected from 1988-1995; however, in the interest of conservatively estimating available disposal capacity, the highest number will also be considered when comparing that available capacity to potential waste generation. A much lower figure will actually result if a large percentage of the CERCLA wastes meet the criteria for the landfill ban in 1988 (landfill ban discussed in "Technology" section of this report).

Regarding the fraction of hazardous materials on remedial action sites which will require management other than on-site stabilization or off-site landfill, prediction is also difficult. However, enough information exists to project a general range of volume of materials from all cleanup sites which might be amenable to incineration. Waste soils and other solids and sludges with significant organic contaminants could reach 20,000 tons per year, though incineration is an unlikely treatment method for any more than 5000 tons per year. Washington and Alaska are expected to generate far more than the other two states and perhaps nearly equal amounts.

Regulatory Change

The amount of material required to be managed as hazardous waste can be dramatically altered by future amendments to state and federal laws and regulations. New listings of materials as hazardous wastes are possible at any time. Though most of the following types of waste are not likely to be fully regulated in the foreseeable future, they are under continued scrutiny.

Waste motor oil from automobiles and industries is regulated only in that combustibles with total halogens in excess of 4000 ppm may be incinerated only in equipment meeting RCRA hazardous waste standards; other used oils meeting certain specifications can be burned in any boiler or in industrial furnaces; off-specification used oil may only be burned in industrial boilers or furnaces. Although much of the used oil is recycled in some fashion, a full listing of those materials as hazardous wastes would add greatly to the potential need for RCRA-approved waste management facilities. Waste oil generation in Region 10 is estimated to be at least 60,000 tons per year.

Mining wastes associated with extraction and beneficiation processes are exempted from regulation as hazardous waste by federal law. Any change in that exemption could affect millions of tons of materials nationally.

Certain dioxin-containing wastes not currently covered by the hazardous waste criteria might be added to the list. Since much of that waste is now handled as hazardous waste by choice, further listing would have little effect on facility needs.

Some of the wastes associated with oil production could conceivably be defined as hazardous in the future. Such wastes might include produced water separated from crude oil streams, liquid wastes from well-workovers, and drilling mud and cuttings. Alaska generates up to 10 million tons of these materials annually.

Regulatory changes other than waste definition can also affect future hazardous waste generation. For example, the adoption of increased disposal taxes and fees, disallowance of certain management techniques, and development of waste reduction incentives could all result in a lower waste generation rate. No forecast of specific amendments is possible.

Summary

Estimates of the major variable factors affecting the future rate of hazardous waste generation are shown in Table 15. Note that the chosen values represent an effort to predict only the order of magnitude of such factors so that the future generation pattern can be projected. Substantial variability will actually be seen year by year. Figure 14 displays a very generalized waste production pattern based on the factors previously described.

The known increase in cleanup waste in 1987 followed by the assumed high levels from those sources for several years maintains the projected generation rate above the 1985 base through the end of the century. Without the cleanup wastes, the generation rate is projected to decrease slightly from the 1985 base by 1988, reach a low point around 1995 and rise above the base level after the year 2000. Considering the large degree of uncertainty associated with the variables used to construct the projection, the depicted fluctuations are quite hypothetical. The only conclusion which can be tentatively drawn is that economic growth might eventually override the benefits of waste reduction, and therefore, the volume of waste to be managed in Region 10 will likely increase to some degree over the next 20 years.

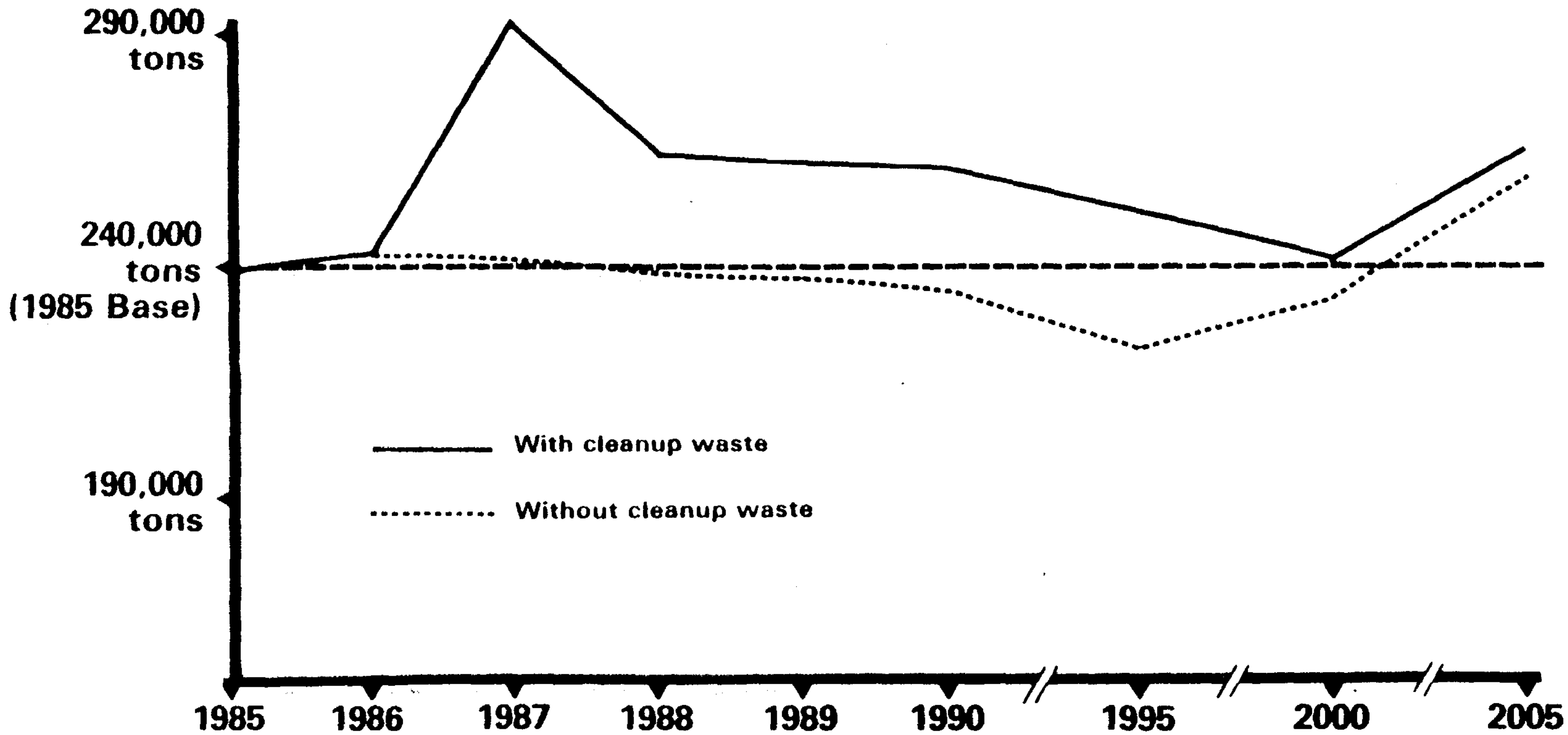


Figure 14

Generalized Projection of Future Hazardous Waste Generation, Region 10

HAZARDOUS WASTE MANAGEMENT TECHNOLOGY

A few basic treatment and disposal techniques have been commonly applied to the management of solid and liquid hazardous wastes for many years. Among them are physical phase separation, neutralization, precipitation, biological treatment, incineration and landfilling. Other more specialized methods have been used less frequently.

Recently adopted disposal standards have prompted the emergence of a growing number of new waste management concepts and variations on the established processes. The new technology runs the scale from simplicity to high sophistication. While the need for new technology is partially spawned by recent regulatory change (notably RCRA waste treatment and disposal requirements), the practical application of that technology has been slowed to some degree by the companion rules which control its use. The EPA Hazardous Waste Engineering Research Laboratory is attempting to test, assess and certify the capabilities of numerous proprietary treatment systems and prospective commercial facilities in time to assure the availability of enough waste management capacity to meet compliance deadlines.

Region 10 hazardous waste generators have entered a period of constant assessment of the dynamic waste management industry as they plan their response to regulatory and economic dilemmas. Current management practices in the region are fairly well known and were discussed in general in a foregoing section of this report. A somewhat more comprehensive view of those current practices is presented by Table 16. Also shown is a more detailed breakdown of waste types and estimated 1985 generation tonnages as well as a listing of waste management methods known to be available at this time (not necessarily in Region 10). A basic classification of waste reduction and recycling potential for each waste type is also offered.

TABLE 16

CURRENT AND FUTURE HAZARDOUS WASTE
MANAGEMENT TECHNOLOGY, REGION 10

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
NONHALOGENATED SOLVENTS AND OILY ORGANICS					
Oily water, emulsions	3500	Deep Well injection Fuel blending	Emulsion breaking Oil/water separation Fuel incineration	XX Separation streams	X Fuel blending
Separation sludge, Slop oil emulsion, Tetraethyl lead sludge, oily sludge	6361	Land treatment	Fuel incineration	X	XX Fuel substitute
Solvents, Still bottoms	3600	Distillation Landfill Incineration	Fuel incineration Rotary kiln incineration	XX Substitution	XX Distillation Fuel blending
Polymeric solid	30	Landfill	Rotary Kiln incineration	X	X
Adhesives	10	Evaporation Landfill Activated sludge	Rotary Kiln incineration Polymerization	X	X
Ink Solvents and sludges with metals	200	Distillation Landfill	Incineration Stabilization	Substitution	X

X = low potential; XX = medium potential; XXX = high potential

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
HALOGENATED ORGANICS					
Solvent liquids	5000	Recycling by distillation, condensation Evaporation	Carbon adsorption Rotary Kiln incineration Liquid injection incineration	XX Separation of internal streams	XXX
Aqueous solutions	500	Evaporation Deep well injection	Carbon adsorption Rotary kiln incineration Liquid injection incineration	XX Separation internal streams	X
Solid, sludges	800	Landfill	Rotary Kiln incineration	X	X
INORGANIC RESIDUALS					
Aluminum proc. black dross	7448	Landfill		X	X
Boiler fly-ash (wood products)	6000	Landfill	Water leaching	X	X
Fluxing salts (Mg. reduction	10,000	Soil amendment Waste pile storage		X	X

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
Graphite anode with lead (Cl production)	250	Landfill	Steel furnace	XX Membrane cell process Steel anodes	XX Steel furnace
Asbestos with lead	100	Landfill		X Membrane cell process	X
Other	400	?		?	?
TOXIC METAL SOLUTION AND RESIDUALS					
Electroplating and metal finishing -solutions	?	Precipitation and landfill	More efficient precipitation methods	XX Process subst. Evaporation Reverse Osmosis Ion exchange Ion transfer	XX Electrolytic metal recovery
-sludges	18,683	Landfill	Cement Pozzolanic	X	XX
Steel emissions control dust	9340	Landfill	Cement Pozzolanic	X	XX Secondary zinc refining Soil amendment
Spent pickle liquor (steel)	4631	Precipitation and landfill	Cement Pozzolanic	X	X Flocculation

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
Sludge from Mercury cell Cl production	300	Landfill	Hypochlorite dissolution Cement	XX Membrane cell process Prepurified salt	X
Other toxic metal wastes	900	Landfill	Cement Pozzolanic	X	X
CHELATED TOXIC METALS					
Solutions	9000	Precipitation and landfill	Improved precipitation methods	XX Process modification Evaporation Reverse Osmosis Ion transfer Ion exchange	XXX Electrolytic metal recovery
Sludges, solids	4000	Landfill	Pozzolanic	X	X
CORROSIVES WITHOUT TOXIC METALS					
Liquids and solids	75,000	Neutralization Landfill residues	Pozzolanic		
TOXIC ANIONS					
Potliner (Alum. Prod.)	10,000	Landfill Storage	Cement kiln incineration Rotary Kiln incineration	X Redesign	XX

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
			Power boiler incineration Fluidized bed incineration (?) Many experimental processes		
Residue from cryolite recovery	3800	Impoundment		X	X
Cyanide solutions	4000	Chemical oxidation	Activated sludge Electrolytic oxidation	XXX Substitution Good housekeeping practices Process modification Evaporation Reverse osmosis Ion exchange Ion transfer	X
Other Toxics	200	?	?	?	?
REACTIVE WASTES					
Torpedo propellent residue, obsolete ammunition, laboratory chemicals	430	Landfill Detonation		X	X

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
Phenyl isocyanate, Other reactives					
PAINT RESIDUALS					
Waterfall paint booth sludge	4000	Landfill Chemical treatment	Rotary Kiln incineration	XX Substitution Process modification	X
Sludge, residues and still bottoms	1000	Landfill	Rotory Kiln incineration	XX Substitution	X
Aged, leftover paints; solvents; containers	2000	Landfill Chemical treatment	Neutralization Rotary Kiln incineration	XX Substitution	X Distillation Sell to sec. user
DISCARDED CHEMICAL PRODUCTS					
Black liquor vanillin manuf.	5000	Landfill	Land treatment Cement Kiln incineration	X	XXX
Laboratory wastes	5	Landfill	Rotary Kiln incineration	X	X

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
PESTICIDES					
Pentachlorophenol and Creosote sludges	3990	Landfill	Incineration	XX Substitute	X
Unused Penta	7	Unknown	Incineration	XX Sell for use	XXX
Tank rinsate (applicators)	50	Solar evaporation and landfill	Activated carbon	X Apply rinsate	X use as makeup water
Other listed wastes	575	Landfill	Incineration	XX Substitution	
PCB					
Liquids (includes capacitor oil)	2400	Incineration	Chemical dechlorination	XXX Manufacture banned	N.A.
Equipment	3500	Rinse, landfill Incineration		XX	N.A.
Soils, etc.	2000	Landfill	Incineration	XXX	N.A.

(continued)

Waste Type	Est. Generation 1985, Tons	Current Methods	Available Methods	Reduction Potential	Recycling Potential
CLEANUP WASTES (NON-PCB)					
Soils, etc.	3000	Landfill	Land treatment (Some organics) Groundwater: Aeration, stripping Evaporation Carbon adsorptoin Ion exchange	XX Encapsulate in place In-situ treatment	X
Demolition debris	3000	Landfill		X Decontamination	X Reuse
MISCELLANEOUS WASTES	10,000	?	?	?	?

From the standpoint of technological application alone, an apparent potential exists for incineration of up to 40,000 tons of regulated hazardous waste per year, based on 1985 data. Including a fraction of the future waste soils which may have significant organic materials, the total incinerable waste could reach 60,000 tons per year; however, two-thirds of that total would probably require fuel-assisted burning, due to low potential heat content. Further, at least 5000 tons of waste are amenable to recycling, and that practice will accelerate. Up to 15,000 tons of liquids (including PCB oils) may be sufficiently pure to allow injection incineration, but, as noted, one-half of that amount can be recycled and much of the remainder is dilute aqueous solution which might be more effectively treated in some other way.

Perhaps 25,000 tons of waste now destined for landfill or impoundment could be handled by other means, particularly incineration. Even if that shift were accomplished, a residual averaging at least ten percent of the original weight would still require landfill or further treatment. In the case of soil and certain equipment and debris, the volume of the residual can be nearly 100% of the initial amount.

Many variations of incineration techonology exist, but some are not commercially available. Cement kiln incineration is a process which will work well for certain wastes in the northwest, including potliner. Although the fluidized bed, multiple hearth and infrared incinerators and the plasma arc pyrolysis process could conceivably be useful in Region 10, the rotary kiln incinerator appears to present the most likely application. That type of burner has the flexibility to handle liquids, sludges and solids while providing the necessary efficiency to comply with RCRA and TSCA standards under most circumstances.

Mobile units might find application in all of the Region 10 states, especially Alaska, for destruction of organic contaminants in soil as well as other wastes. Any estimate of waste from remedial action sites to be actually available for incineration in future years would be highly speculative. One landowner has already contracted to use a process which thermally removes and captures organics (including PCB's) from soil at a major site in Alaska; final disposal must then be applied to a much less voluminous waste. The results of the RCRA permitting process pertaining to other technology, such as injection wells in Alaska, will affect the amount of material which might be available for incineration in the region.

Chemical detoxification might be employed for certain wastes in the northwest. Various reagents are being developed for dehalogenating organic wastes such as PCBs. Some Washington wastes are being treated in that fashion at facilities outside Region 10. Other specialized technology might be applicable in future years for routinely generated wastes or for remedial action projects. Experimental methods include treatment of organics by such organisms as white rot fungi and highly specific bacteria and yeasts. Available in-situ procedures and other on-site methods of treating contaminated soil and groundwater are too numerous to detail here.

One of the primary purposes of this survey is to contemplate the future of hazardous waste landfilling in the region. Hypothetically, as much as 180,000 tons of waste could be landfilled annually if solidified, stabilized or encapsulated. Numerous methods and materials are available to accomplish such containment, including cement, lime and pozzolanic solidification; glassification; polymerization; thermoplastic solidification; sorption; and various means of macroencapsulation. However, many factors dictate that a large increase in the landfilling of wastes generated in Region 10 will never occur.

One specific overriding factor must be considered when projecting available waste for landfilling. The 1984 RCRA amendments established a comprehensive program of evaluation of all hazardous wastes for the purpose of banning the landfilling of any waste for which alternative technology exists and those wastes which cannot be permanently immobilized. A complex sequence of study and regulation began.

Certain solvent wastes and dioxin-containing wastes were to be banned in November, 1986. Wastes with greater than one percent of the listed solvents were held to the 1986 deadline, but solvent-water mixtures of lesser concentration, solvent-inorganic sludge mixes, solvent-contaminated soils and small quantity generator wastes were issued a two-year variance (November 8, 1988). Due to a lack of national waste disposal capacity, dioxin-containing wastes received the same time extension.

The so-called "California list" of wastes is banned from landfill as of July, 1987 (the California list wastes were banned from landfill in Idaho by state law on July 1, 1986). The list includes liquid wastes containing free cyanides in concentrations equal to or greater than 1000 milligrams per liter; liquid wastes containing certain metals (or elements) or compounds of same above specific concentrations; liquid wastes with a pH equal to or less than 2.0; liquid PCBs at a concentration equal to or greater than 50 ppm; and wastes containing halogenated organic compounds in total concentration equal to or greater than 1000 mg/kg.

CERCLA wastes are exempt from the landfill ban until November, 1988. By August, 1988, EPA must study the first one-third of the RCRA-listed wastes and adopt regulations establishing treatment standards for each waste. After that date, no such waste may be landfilled unless the contaminants are reduced to the standard concentration. If the agency fails to adopt regulations, all of the listed wastes will be banned. Regulations pertaining to the second one-third of the listed wastes must be adopted by June, 1989, and for the final one-third by May, 1990. "Characteristic" wastes are to receive the same consideration by 1990.

For this report, the Region 10 wastes were evaluated in terms of their potential coverage by each phase of the landfill ban regulations. Table 17 presents an array of estimated maximum tonnages which could be banned from landfill at each step of the regulatory process. Note that these estimates are crude and probably overstate the true potential for landfill ban because the concentrations of pollutants in the various Region 10 wastes are unknown. Those determinations will be made on a case-by-case basis by the generators and waste management firms. Moreover, not all of the wastes will actually be banned, since no alternative disposal method will be found for some, and some wastes will be landfilled after treatment.

Available data do not clearly establish the physical form of reported metals-containing wastes. Most sludges will be considered to be liquids for the purposes of the California list rule. The figures shown in Table 17 are high to some degree because a fraction of the metals waste is dry solids. However, if not subject to the California list rules in 1987, they will be covered by the "characteristic" rule in 1990.

TABLE 17

ESTIMATED MAXIMUM POTENTIAL LANDFILL BAN,[1] REGION 10
BASED ON 1985 GENERATION DATA (TONS)

Category	DATE	AK	ID	OR	WA	REGION 10	1985[2]
Solvents	1986-88	70	140	2700	11,500	14,410	91
Dioxin	Nov., 1988	0	0	260	7	267	0
California List	July, 1987						
Cyanide		50	340	3300	19,000	22,690	1227
Metals		600	620	4300	28,000	33,520	6570
Acids		10	90	2900	7000	10,000	400
PCB		180	260	700	1230	2370	?
Hal. Organics		50	400	1950	3230	5630	1530
CERCLA Wastes	Nov., 1988	0	0	0	1000	1000	?
RCRA-Listed							
First one-third	Aug., 1988	20	40	3500	15,500	19,060	4150
Second one-third	June, 1989	2	2	25	5	34	11
Third one-third	May, 1990	2	0	0	0	2	1
Characteristic	May, 1990	675	375	7500	8,800	17,350	447
Total		1659	2267	27,135	95,272	126,333	14,427

1. Washington-regulated wastes not considered

2. Region 10-generated waste landfilled in 1985

If all of the waste categories under study (other than characteristic wastes) were to be actually banned, and if none of the Region 10 waste meets the disposal standards prior to treatment, about 109,000 tons of waste would be banned from landfill by 1990 unless properly pretreated. That conclusion is based partially in the assumption that the Washington-regulated wastes will not be banned (a weak assumption). About 17,000 tons of waste would theoretically be amenable to landfill without treatment unless banned by "characteristic waste" regulations.

Over 14,000 tons of solvent wastes would be banned by 1988 (some were banned in 1986). Far less than that amount is being landfilled now. The 1985 data show 265 tons of banned dioxin-containing waste in the region. None is reported from Alaska or Idaho, but small amounts are known to be in storage in those states, awaiting disposal.

Nearly 75,000 tons of reported waste could be subject to the "California list" ban, if none of that waste currently complies with the maximum concentration limit. Obviously, no such amount of those wastes is being landfilled now. By mid-1985, Section 3004 (c) of the RCRA regulations had already banned the landfill of bulk or non-containerized liquid hazardous wastes and free liquids contained in hazardous wastes (even with absorbents). That regulation, of course, extends to California list wastes, and probably had a substantial effect on the 1985 data. As liquid wastes are the main focus of the California list regulation, that regulation is more likely to affect the wastes being placed in surface impoundments than those being land-disposed. The obvious exception is non-liquid wastes containing greater than 1000 mg/kg halogenated organic compounds (Region 10 = up to 5600 tons).

The apparent maximum effect of the regulation of the first one-third of the RCRA-listed wastes will be a ban on landfilling of approximately 19,000 tons of waste from Region 10. As indicated by Table 17, virtually no Region 10 waste will be impacted directly by the regulations pertaining to the remaining two-thirds of the RCRA list, because most of that waste will already be covered by the California list rules.

Of the nearly 127,000 tons of RCRA-regulated wastes and PCB oil generated in 1985, only 14,427 tons were landfilled within the region, all at commercial facilities in Oregon and Idaho. Therefore, almost 112,000 tons of the waste which will be subject to potential landfill ban were already being handled in some other fashion. Since only 13% of the wastes were being landfilled, and the physical state of those wastes is unknown, the specific effects and timing of the ban cannot be determined. However, it is apparent that the ban will have virtually no effect on the landfilling of solvents and currently-regulated dioxin-containing wastes, since very little has been managed in that way in the past.

Without question, shifts in the use of hazardous waste management methods will occur in Region 10 in response to economic incentives, technological advances and governmental requirements. Equally apparent is the need for a coordinated approach to waste management in the region by all parties if compliance with regulations is to be achieved at reasonable cost. The unique logistical features of Region 10 dictate that no single facility, process or system will solve the diverse problems facing the waste generators. The ultimate disposition of each lot of hazardous waste will depend on the results of chemical analysis performed pursuant to the new waste disposal regulations. In fact, assurance of the availability of a sufficient supply of high quality laboratory facilities (and monitoring those facilities) may prove to be the most imposing challenge facing waste managers in Region 10.

WASTE MANAGEMENT CAPACITY

The combination of technical, economic and regulatory factors which will determine the actual application of waste management technology to particular waste streams is so complex as to discourage analysis. Nevertheless, the general information compiled in this report provides a basis for a rational estimation of the current and future need for basic waste management facilities in Region 10. Some data are available regarding the capacity of existing and proposed facilities as well.

Waste management capacity cannot be simply defined. Storage capacity is nothing more than the space available for waste piles and drums and the volume of tanks and impoundments. Treatment capacity is limited by various throughput limitations of the facilities. In the case of batch-process tanks, capacity might be limited by tank size, chemical reaction rate, available manpower or some other factor. Flowthrough liquid treatment facilities are limited by hydraulic design and incinerators by combustion chamber design. Impoundment capacity is initially determined by pond size and the availability of additives (such as waste acids and bases for neutralization) and ultimately by evaporation rate, once the pond is full. Landfill capacity is normally expressed in terms of total life of the facility (years, volume, weight), although logistics and personnel limitations will establish a practical daily capacity as well.

The foregoing sections of this report have outlined the volume and character of the Region 10 wastes, the current handling methods and potential technological application. The availability of facilities for handling those wastes during the next ten years can be estimated only through compilation of data from RCRA and TSCA facility permit files and by securing business plans directly from waste management companies. Both methods were attempted during this assessment.

On-site facility capacities for the standard EPA waste management categories were totaled from the permit data files. Off-site storage capacity was determined in the same way. These figures must be viewed with some suspicion, however, because much of the data came from "Part A" applications and are neither recently submitted nor verified. Moreover, while most of the facilities decribed by the permit applications currently exist, some are only proposed for construction. Data verification and permit issuance to current applicants will not necessarily be complete for five years. RCRA deadlines require permit issuance for landfills by 1988, incinerators by 1989, treatment by 1990 and storage by 1992.

Off-site treatment and disposal capacities were estimated by reviewing operating permit ("Part B") application data and closure plans and through discussions with managers of the major waste management companies in the region. That information allowed the production of a summary of treatment capacities according to general waste types rather than the less meaningful treatment method categories. The projections made in this fashion, while not fully verified, are at least based on recent data. The on-site facility capacities are presented in Table 18. For comparison, the 1985 actual on-site storage, treatment and disposal tonnages are reiterated in the Table. Proposed storage facilities would accomodate nearly 300,000 tons of waste, mostly in waste piles. Actual 1985 storage totaled just over 100,000 tons. Treatment facilities proposed for permit would likewise handle much more waste than that treated on-site in 1985. Similarly, proposed disposal facilities would be capable of dealing with more waste than the amount disposed of by each method in 1985.

TABLE 18

ON-SITE HAZARDOUS WASTE MANAGEMENT FACILITIES

APPROXIMATE PROPOSED PERMIT CAPACITY, REGION 10[1]

	AK	ID	OR	WA	REG. 10	1985[2]
STORAGE (Tons)						
Container	1600	250	10,000	3100	14,950	4365
Tank	12	1150	1290	22,000	24,452	4213
Pile	0	0	6200	225,000	231,200	91,720
Impoundment	0	250	9000	200	9450	6997
TREATMENT						
Tank (Tons)[3]	17	0	7200	1800	9017	4919
Impoundment (Tons)[3]	0	0	0	18,000	18,000	0
Incincerator (Tons/Yr.)	0	2100	1000	1600	4700	2437
Other (Tons/Yr.)	0	10,000	3300	1.1[4]	1.1[4]	1938
DISPOSAL						
Injection Well (Tons/Yr.)	3000[4]	0	0	0	3000	496
Landfill (Tons/Yr.)	0	0	0	40,000	40,000	32,037
Land Appl. (Tons/Yr.)	0	0	0	17,000	17,000	1445
Impoundment (Tons)[3]	0	0	340	34,000	34,340	28,982

1. Some facilities existing, some not
2. Amount actually handled in Region 10 in 1985
3. Total containment capacity; potential throughput unknown
4. Millions of tons; includes wastewater treatment and disposal facilities

Permits for three to five injection wells have been requested by the petroleum extraction industry on the Alaska North Slope. The Arco Prudhoe Bay wells would accomodate 470 tons of waste per day, while the Standard Oil injection well would handle as much as 10 million tons per day. In neither case would regulated hazardous waste be disposed of in quantities even close to those totals (prior to mixing). Rather, the wells will be used primarily for disposal of unregulated wastewaters.

EPA's proposed underground injection control regulations require that the waste stay within the injection zone for a certain period of time. This factor and many other technical and policy matters will determine whether or not the permits will be issued. The outcome of the permitting decision will, of course, bear greatly on the need for implementation of other waste disposal options (such as incineration) in Alaska, as will the decision of the well owners regarding acceptance of off-site wastes for injection if the wells are permitted.

Most of the permit applications for on-site waste management reflect the pattern of existing facilities in the region. The most notable exceptions are the proposed small incinerators. If approved, those burners would be built at federal facilities in Idaho and Oregon, and at a wood products plant in Washington.

Table 19 presents estimates of off-site waste management facilities proposed for permit in Region 10. Storage, treatment and disposal permit applications again relate primarily to existing facilities, but some new projects have been proposed. Off-site storage capacity easily exceeds the

TABLE 19

OFF-SITE HAZARDOUS WASTE MANAGEMENT FACILITIES

APPROXIMATE PROPOSED PERMIT CAPACITY REGION 10[1]

	AK	ID	OR	WA	REG. 10	1985[2]
STORAGE (Tons)						
Container	0	870	600	7000	8470	7012
Tank	0	705	420	11,000	12,125	9940
Pile	0	4700	0	60,000[3]	64,700	57,000
Impoundment	0	75,000[4]	83,000[4]	5000	163,000[4]	18,000[4]
TREATMENT (Tons/Yr.) Physical/Chemical						
Oil Recovery	?	0	?	35,000	35,000	12,000
Solvents recovery	0	?	?	200,000[6]	200,000	?
Anions	0	0	0	10,000	10,000	3000
Organics	0	0	0	15,000	15,000	12,000
Corrosives/Metals	0	20,000	25,000	100,000[5]	145,000[5]	23,500
Incineration	0	0	0	50,000[7]	50,000[7]	0
DISPOSAL						
Injection Well (T/Yr.)	?	0	0	0	?	615
Landfill (T/lifetime)	0	1.57[8]	2.07[8]	1.4[7,8]	5[8]	76,695

1. Some facilities existing, some not

2. Amount actually handled in Region 10 in 1985, including state-regulated

3. Not RCRA

4. Also treatment

5. Other than NPDES wastewaters

6. Includes capacity for exempt wastes

7. Proposed only

8. Millions of tons

space actually used in 1985. Information on treatment is sketchy, but as stated earlier, the permit file data were augmented by new estimations secured from facility managers regarding the waste treatment throughput potential of their facilities. That information allowed a rough separation of physical/chemical treatment processes into groups labeled in Table 19 as oil recovery, corrosives/metals, solvent recovery (other than alternative fuel blending), anion destruction and treatment of organic materials.

Excess capacity (relative to projected waste generation) for neutralization of liquid corrosives with or without metals will be available if permits are issued for facilities existing or proposed in Idaho, Oregon and Washington. No deficiencies are apparent in the systems available to handle oils, solvents and cyanide (facilities mostly in Washington). While some capacity to chemically treat organics exists, little was learned about the scope of those capabilities during this assessment.

No off-site incinerators have been yet approved or constructed within Region 10. One major facility with the capacity to burn up to 50,000 tons of waste per year has been formally proposed for construction in central Washington. Plans for another (competing ?) project have been revealed by a consortium of waste management firms, but no permit application has yet been filed. Obviously, the actual construction of such a facility would have a profound effect on future waste management practices in the region.

The capacity of existing landfills for disposal of hazardous waste within the region is large and would be augmented substantially by the construction of a facility associated with the proposed incinerator in central Washington.

Oregon's landfill capacity as outlined by the current permit application is slightly more than two million tons of waste. That figure represents the amount of land dedicated to landfill for the term of the proposed permit (10 years). Note, however, that the major facility operator owns enough land to easily triple that capacity in the vicinity of the existing landfill, but no assumption can be made regarding that possibility.

In Idaho, the commercial landfill space proposed for permit would accomodate 1.5 million tons of waste. However, the actual remaining capacity of the land planned for waste disposal at the site is about two million tons. The proposed Washington facility would add 1.4 million tons of capacity, for a regional total of approximately five million tons of waste.

Idaho and Oregon landfill lifetimes were calculated on the basis of several possible waste disposal rates and reported in Figures 15 and 16. If the Oregon facility were to continue to receive waste at the same rate as in 1985 (82,000 cubic yards/year), the life of the landfill as proposed for permit would be 18 years (2005); at the higher 1986 rate of fill (102,000 cubic yards/year), the life of the facility would be 12 years (1999). However, the closure date of the land disposal cells proposed for permit is estimated by the company to fall in 1996; receipt of over 164,000 cubic yards of waste per year would be required to fill the site by that time. Such a rate of fill is possible, but would require a broader market or volume increase due to waste stabilization and expanded CERCLA waste business. None of the scenarios depicted by Figure 15 would alone provide 20 years of disposal capacity in Oregon, but as permits are limited to a 10 year duration, facility proposals for the second decade are unknown.

Figure 15

Commercial Hazardous Waste Landfill Capacity, Oregon

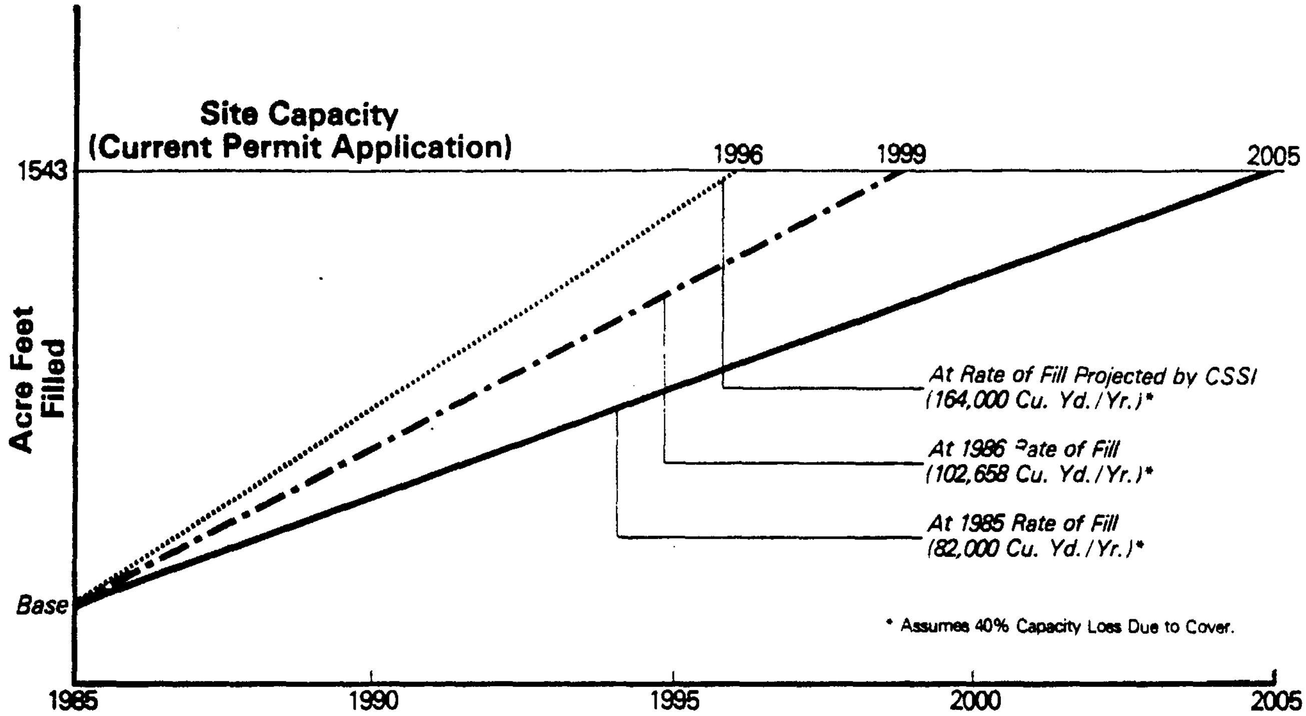
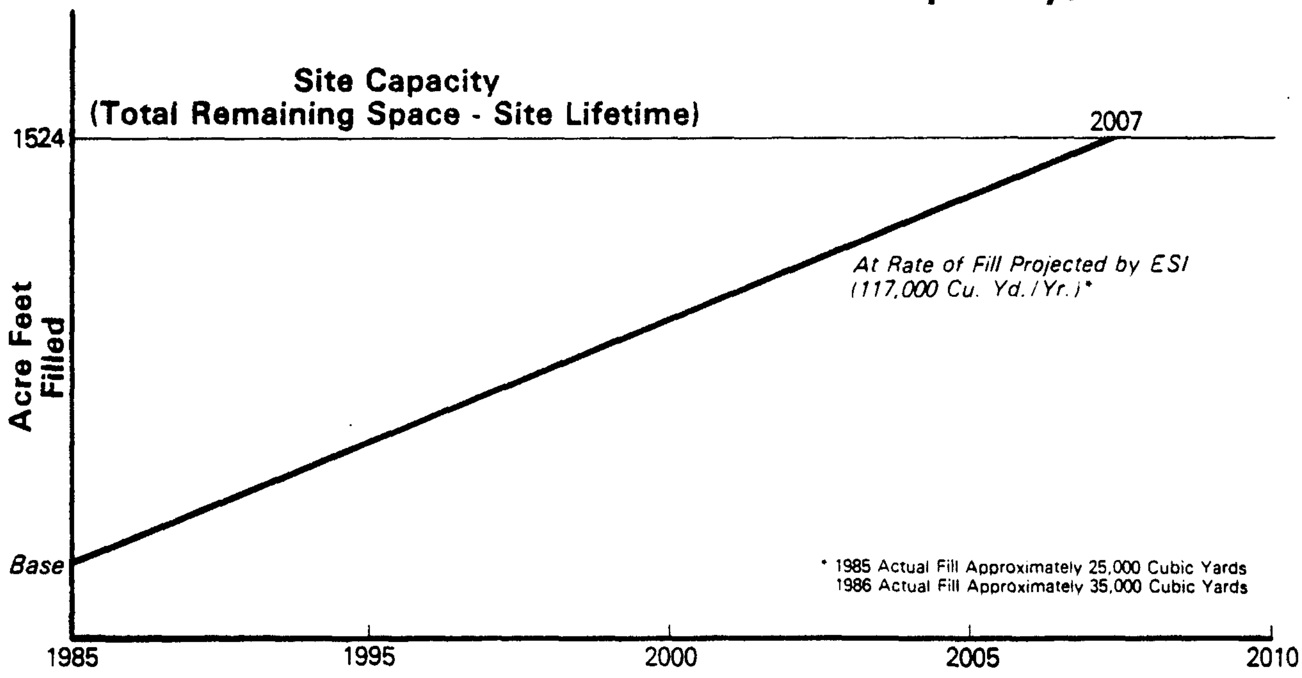


Figure 16

Commercial Hazardous Waste Landfill Capacity, Idaho



Since the Idaho facility is rebuilding its RCRA waste disposal business following several years of self-imposed restricted activity, projection of facility life can be based only on company plans as discovered during this assessment. Apparently, wastes averaging 117,000 cubic yards per year are expected to be received at the existing site (if permitted); that rate of fill would result in closure of the facility exactly 20 years from now (2007). For comparison, the 1985 and 1986 rates of fill were approximately 25,000 and 35,000 cubic yards, respectively. Therefore the landfill activity at the site would have to be quadrupled to utilize available capacity within 20 years. Further, the character of the waste stream will change dramatically, because soon the Idaho site will no longer receive the PCB wastes which have dominated its business in recent years.

Potential Capacity in the West

As previously discussed, Region 10 waste generators currently ship a significant portion of their hazardous wastes and PCB wastes to facilities in nearly two dozen states for treatment and disposal, and might have to ship even more as new regulations reduce the local options. Much of the exported waste is treated or landfilled in California and Nevada or sent to the Midwest for incineration. National data suggest that a waste disposal capacity shortfall of some proportion will occur within the next five years unless proposed facilites are permitted and built faster than expected.

Region 10 clearly has sufficient landfill capacity for the next decade if existing facilities are issued permits. Obviously, approved commercial incineration capacity in the region is zero unless TSCA-permitted mobile units are brought in. Much of the permit review process still lies ahead for the only formally proposed major incinerator project in the region, and no application has yet been developed for the informally proposed facility. Therefore, those projects could well be in competition with similar ventures in adjacent regions.

Permit applications for at least four new major commercial incinerators have been submitted in EPA Region 9. Proposed facilities for southern California would handle about 60,000 tons of waste and those planned for northern California could burn nearly 300,000 tons of waste per year. The largest of those is an existing sulfuric acid regeneration furnace which would be modified to accept hazardous waste as a heat source. A permit decision on that facility could occur as early as March, 1988. Two other incinerators might be built in Region 9, one on the site of an existing major landfill in California; the other is the well publicized ENSCO project in Arizona. No permit application has been submitted for either of them.

In Region 8, eight separate commercial incineration facilities are being planned by different entities (total capacity over 100,000 tons per year). The proposed sites which are closest to the Region 10 states are in northern Utah. The permit application for one of those sites is being actively considered at this time. In both of the regions adjacent to Region 10, permit decisions could be made on more than one incinerator within the next 18 months.

The foregoing information is provided for consideration by Region 10 waste management planners because the incineration market, while clearly expanding in the West now, is nonetheless limited, and the few projects permitted first may be the only ones built. That eventuality underscores the need for quickly augmenting all aspects of the hazardous waste management planning process in the region if the full range of options is to be considered.

PROBLEMS/RECOMMENDATIONS

The hazardous waste reporting sytems employed by EPA and the Region 10 states collectively embody a powerful program planning tool, but certain shortcomings of those systems became evident during this assessment. Problems were encountered regarding the timeliness of generator and facility surveys, the accuracy of data, and the scope and comparability of summary reports. Those problems are generally reflective of the list of system deficiencies noted recently by the National Governors' Association in its report to the EPA Office of Solid Waste on hazardous waste reporting system design.

Comprehensive waste generation and waste handling data bases are necessary for various program purposes, including compliance evaluation, determination of waste management facility needs, estimation of potential for waste reduction, development of national, regional and state waste management strategies, and efficient assignment of program resources. Such diverse missions cannot be served without a data system which accounts for hazardous wastes on a mass balance basis. The Region 10 systems fall short of that capability for the following reasons:

1. Data are not entered into a common electronic system; computer-aided regional analysis is not possible.

2. States and EPA regulate different waste materials and different volumes or concentrations of the same materials.

3. State and EPA data verification (quality control) procedures and level of effort are significantly different. The Washington DOE is the only Region 10 agency routinely conducting a substantial data

verification program. In spite of the impressive effort made by the Washington agency, a waste management facility reporting error amounting to ten percent of the waste generated in the state in 1985 was not discovered by DOE but was noted during the current assessment. Generator and facility reporting discrepancies in Alaska were as high as a factor of two or three. Waste characterization as outlined by the Idaho annual report differed greatly from that shown by the EPA biennial report for nearly the same period of time. The Oregon biennial report did not account for the importation of Washington-regulated wastes.

4. Sequential waste management steps are not adequately reported, resulting in a variety of problems, such as the double or triple-counting of wastes, insufficient identification of treatment processes employed, and inconsistent reporting of wastewater/residual volumes.

5. Biennial reporting frequency is inadequate and reports are generally produced too late for good program planning and evaluation (up to 15 months after end of year).

6. Waste characterization data are not sufficiently comprehensive. Each waste lot is identified by one or more three digit characterization codes; only one such code number can be entered into the EPA data management system (even for mixtures) although it cannot fully describe the waste.

7. The list of notifiers (registrants) may not reflect the actual universe of potentially regulated entities.

8. State and EPA survey instruments differ substantially (EPA uses the national questionnaire for Alaska and Idaho; Washington has developed a more comprehensive form; Oregon relies on the individual shipment manifests).

9. No common format is required for reporting of the waste minimization efforts of industries and other generators and therefore the information cannot be compiled in any fashion; virtually no quantitative data are collected.

10. The outright reporting exemption for recycled wastes, etc., produces an incomplete waste management picture.

11. When waste is sent outside the region, its specific treatment or final disposition is not reported to the state of origin.

12. No information is reported regarding the capacity of waste management facilities.

13. The EPA computerized biennial reporting system displays data under confusing headings. For example, the "disposition of in-state wastes" is, in fact, a report of wastes from <u>all</u> sources (including other states) which are treated or disposed of in a state. The system will not track the disposition of wastes generated only

within a state; thus, a mass balance determination of in-state generated wastes is impossible through the use of biennial report printouts alone.

None of these frailties invalidates the information contained in this report and the documents on which it is based, because the particular conclusions reached as a result of this assessment required only order-of-magnitude level data; the biennial reports are much more precise than that. Nevertheless, if the Region 10 states are to evaluate the hazardous waste handling problem to an extent sufficient to ensure the application of the most cost-effective and health-protective management methods, a more comprehensive reporting and analysis process must be developed.

Such a process should include at least the following features:

1. A single report form to be used by all states (or as the core of any state-developed form) to collect data both from hazardous waste generators and waste management facilities.

2. Surveys conducted at least annually and summary reports issued without great lag time.

3. Clearly-stated reporting requirements, particularly with regard to definitions of reportable wastes (for example, under what circumstances are volumes of wastewaters reportable prior to treatment? Conversely, when are treatment residuals reportable as newly generated wastes?)

4. An annual determination of the regulatory status of all potential generators.

5. Verification of all generator and facility-reported data by state agencies and EPA (staff augmentation required).

6. Characterization of wastes in terms of physical form and all relevant chemical components (within the limits of practical analysis) through use of a more complex coding system.

7. Tracking of wastes throughout the country and reporting of treatment and ultimate disposal of those wastes to the regulatory agency in the state of origin.

8. The capability to account for stored wastes at the beginning as well as at the end of a reporting period.

9. More detailed description of waste treatment processes through a more complex coding system.

10. The capability to compare the volumes of various wastes on an annual basis and to determine the degree to which each generic means of waste reduction is employed by each category of industry.

11. The capability to determine the remaining permitted capacity of landfills on an annual basis and the practical throughput capacity of treatment facilities.

12. The entry of all core data into a commonly accessible automated system.

At the national level, EPA and the states are addressing the problems of the biennial reporting system under the auspices of an advisory council formed by the National Governors' Association at the request of EPA. The council is composed of representatives of the RCRA-regulated community and environmental interest groups as well as EPA and state agencies. Alternatives are being considered for upgrading and coordinating the data collection process. The council has identified five major objectives to be pursued through a new reporting system: determination of regulatory status of waste handlers; improved waste characterization; more complete waste tracking; better documentation of waste minimization programs; and development of information regarding TSDF capacity.

Plans are also being formulated to develop new software for the handling of hazardous waste management data. Such a system could be operational by mid-1988. The package would facilitate data entry to a redesigned central data processing system by all states from newly designed survey forms, allow validation of data entry, produce summary reports and provide protocols for processing of data. It is recommended that Region 10 state agencies actively participate in the development of the program, contribute in timely fashion to the national data base, and ultimately use the analytical capability of the system to the degree that it meets the requirements of the agencies.

Further, it is recommended that the Region 10 states, individually or collectively, conduct intensive studies of waste management capacity and waste reduction potential as soon as practicable. Waste reduction studies should include the determination of industry unit productivity so that a true calculation of the effects of future reduction schemes can be made.

Arrangements for holding confidential any such information pertaining to individual companies will likely be necessary. The capacity surveys will require considerable direct contact and discussion with waste management industries as well as detailed review of permit applications to secure information on the true capabilities of waste management facilities and likely waste sources to be served by those facilities; the EPA RCRA facility permit data summary reports are neither sufficiently detailed nor up-to-date for that purpose, because only a relatively few permit applications are being intensively processed at this time.

Agencies should solicit the assistance of industry representatives and other interested parties through the formation of investigation steering committees or other suitable means. Once the baseline data are in place from these one-time studies, the ongoing reporting processes previously discussed will provide updated information which can be augmented with infrequent independent followup surveys. EPA and the Region 10 states have an opportunity to develop planning mechanisms which will ensure appropriate handling of hazardous waste in the future, but to do so, the management officials must have access to an improved data collection system very soon.

Critical hazardous waste management policy will be established in the northwest states during the next two years, whether by active design or passive acceptance of the initiatives of the national marketplace and regulatory programs. The people of the Region 10 states will be best served by the creation of clear processes for reaching joint conclusions regarding data systems, facilities development, technology transfer and public health objectives. True public participation should be the hallmark of those processes, from basic policy formulation to ongoing program management.

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