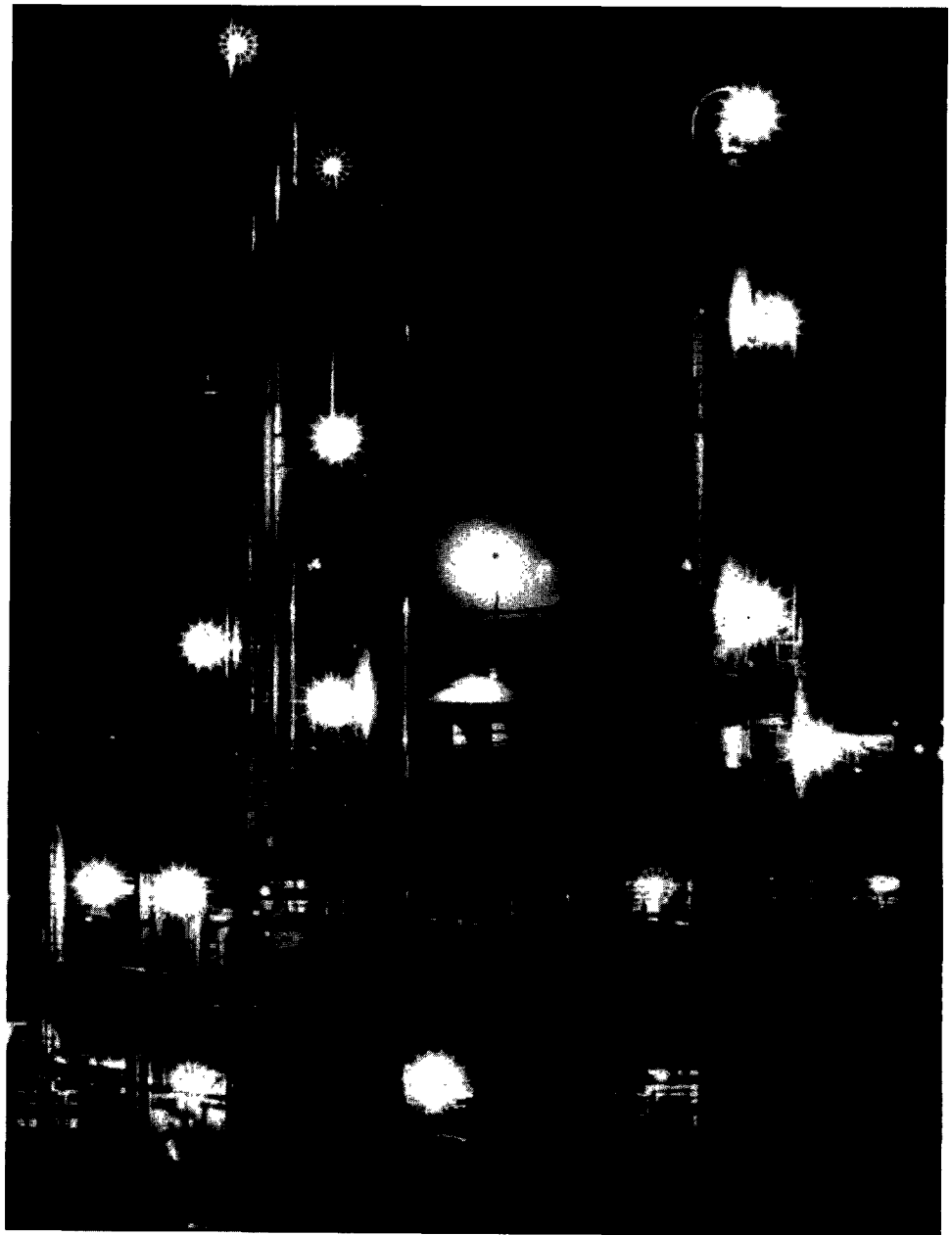




The Toxics-Release Inventory

Executive Summary



THE 1987 TOXICS RELEASE INVENTORY: AN INTRODUCTION

The 1987 Toxics Release Inventory was mandated by the "Emergency Planning and Community Right-to-Know Act" enacted by Congress in October of 1986. The law, also known as Title III of the Superfund Amendments, is based on the premise that citizens have a "right-to-know" about toxic chemicals in their communities, and has two main purposes: to encourage planning for response to chemical accidents; and to provide the public and the government information about possible chemical hazards in their communities. The law requires States to establish State Emergency Response Commissions and Local Emergency Planning Committees to collect detailed information of local manufacturers.

The law further requires certain manufacturers to report to the U.S. Environmental Protection Agency (EPA) and to States the amounts of over 300 toxic chemicals that they release directly to air, water, or land, or that they transport to off-site facilities. In addition, the law specifies that the EPA must compile these reports into an annual inventory of releases and transfers—the Toxics Release Inventory (TRI)—and make the inventory available to the public in a computerized database. This report summarizes release and transfer data for 1987, the first year of data collection under TRI.

Who Must Report to TRI?

TRI requirements for 1987 covered all manufacturing facilities in the 50 states, the District of Columbia, Puerto Rico, American Samoa, the Northern Mariana Islands, and the U.S. Virgin Islands that met the following conditions:

- they produced, imported, or processed 75,000 or more pounds of any of the 328 TRI chemicals, *or* they used in any other manner 10,000 pounds or more of a TRI chemical;
- they were engaged in general manufacturing activities ; and
- they employed the equivalent of ten or more employees full time.

Which Toxic Chemicals for 1987?

The 1987 TRI reporting requirements covered more than 300 toxic chemicals and 20 categories of chemical compounds. The TRI chemicals vary widely in toxicity and in the frequency, amounts, and industrial processes in which they are used.

What Constitutes a TRI Release?

TRI calls for facilities to report the amounts of the listed toxic chemicals that are **released** directly to air, water, or land. In addition, manufacturers must report amounts of chemicals that are transported (transferred) **off-site** to facilities, including public sewage systems, that treat or dispose of the chemical wastes. Both routine releases and accidental spills or leaks must be reported. Facilities must report even if their releases comply with all environmental laws and permits. TRI data is not necessarily an indication of regulatory violations.

What to Report?

EPA required that manufacturers submit a TRI data form (EPA Form R*) for *each* TRI chemical they manufactured or used in 1987. The information requested on the TRI form includes facility address and other identification, off-site locations to which TRI chemicals are transferred in wastes, and specific chemical information for releases, off-site transfers, and treatment.

* FOR A COPY OF FORM R AND INSTRUCTIONS FOR COMPLETING IT, CONTACT:
EPA DOCUMENT DISTRIBUTION CENTER, P.O. BOX 12505, CINCINNATI, OH 45212.

The 1987 Toxics Release Inventory: A National Summary

Total Releases and Transfers of TRI Chemicals

In 1987, the first year of reporting under the Toxics Release Inventory (TRI), manufacturing facilities reported the release of 18.0 billion pounds¹ of TRI chemicals directly into the air, water, land or underground wells, and an additional 4.6 billion pounds of TRI chemicals transferred off-site to other facilities, such as public sewage systems or incinerators, for treatment or disposal. All told, TRI encompassed 22.5 billion pounds of releases and transfers in its first year of reporting (Figure 1-1). A total of 19,278 manufacturing facilities submitted 74,152 individual chemical reports, or an average of almost four TRI chemicals per facility.

Eighteen billion pounds of TRI chemicals were released to the environment in 1987 and 4.9 billion pounds were transferred off-site for treatment or disposal.

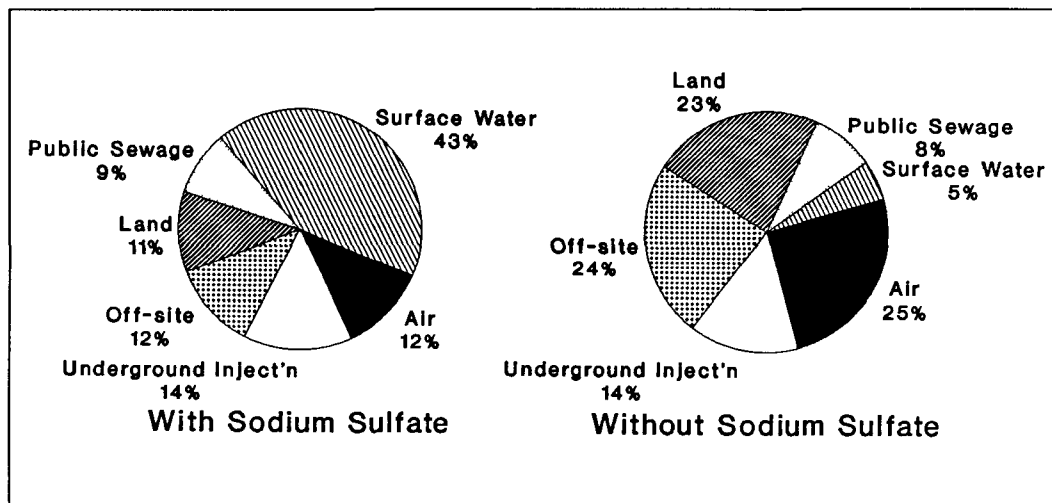


Figure 1-1.

Total TRI Releases and Transfers, 1987. Total with sodium sulfate: 22.5 billion pounds. Total without sodium sulfate: 10.4 billion pounds.

¹ This report is based on data retrieved from the March 15, 1989 version of EPA's TRI database. Numbers reported may differ slightly from those available now. Figures cited here and throughout the text of this report have been rounded off, so totals may not always be exactly the same. Refer to tables for exact data.

Sodium sulfate accounted for more than half of all TRI releases and transfers in 1987.

Over half of the TRI total consisted of a single chemical—sodium sulfate. Because it was reported in such large amounts, sodium sulfate affects the overall patterns of releases and transfers presented here, sometimes obscuring smaller releases of more toxic TRI chemicals. The influence of this one chemical, which may be removed from the TRI list, is discussed throughout this report (Box 1-B).

TRI release data reveal the amounts of TRI chemicals that are annually and routinely discharged into the environment (Box 1-A). These data do not, however, directly gauge the amounts of chemicals to which humans or the environment are *exposed*, nor do they measure the *risks* posed by TRI chemicals. Many factors combine to determine how much of a risk, if any, is imposed by particular releases and transfers of TRI chemicals (Box 1-C). Nor are the releases necessarily an indication of violations of environmental laws; many EPA and State programs permit some releases of toxic chemicals under controlled or properly managed conditions that prevent or minimize risks.

The following sections present selected highlights of TRI data on the nation-wide releases and transfers of TRI chemicals:

- how TRI chemicals were released to air, land, and water or transported off-site
- where TRI chemicals were released in 1987
- which industries played major roles
- which chemicals played major roles

TRI AT A GLANCE

What is TRI? A compilation of information reported to EPA on more than 300 chemicals used or released to the environment by manufacturers in 1987.

Who reports? Manufacturing facilities in the U.S. that manufactured, imported, or processed more than 75,000 pounds of the 328 TRI chemicals or used more than 10,000 pounds of TRI chemicals and that employed ten or more workers full time during 1987.

Where are TRI data kept? Manufacturers submitted TRI reports to the EPA and to state environmental agencies. The EPA maintains TRI data on a computerized database, available to the public through the National Library of Medicine's TOXNET computer network.

When was TRI compiled? Manufacturers were required to submit forms describing their 1987 releases by July 1, 1988. Reports will continue on an annual basis.

Limitations of TRI. Not all sources of toxic chemical wastes are included in TRI, and not all facilities which should have reported did so. The quality of the reported data must be viewed cautiously, since this is the first year of industry experience with TRI.

Box 1-A.

SODIUM SULFATE AND TRI

Sodium sulfate releases and transfers of more than 12 billion pounds dwarf all other chemicals reported to TRI in 1987. Sodium sulfate alone accounts for 54 percent of total releases and transfers for all TRI chemicals. Moreover, a single facility in California released 5.2 billion pounds of sodium sulfate, accounting for 23 percent of total national releases and transfers.

EPA has been petitioned to remove sodium sulfate from the list of TRI chemicals requiring reporting due to an apparent absence of significant toxicity concerns for this chemical. If the petition is granted the portrait of TRI releases and transfers will change dramatically.

For example, California, which in 1987 had the largest amount of TRI chemical wastes, would drop to ninth in the nation without sodium sulfate. Discharges to surface water, which ranked first with a lion's share of the sodium sulfate releases (75 percent of the total sodium sulfate releases for 1987) would drop to last place of all the types of releases and transfers (Figure 1-1). The acids/bases/salts class of chemicals, which accounts for 69 percent of total TRI releases and transfers, would drop to only 33 percent without the influence of sodium sulfate. And of course, the total amount of TRI releases and transfers would be cut by more than half.

Box 1-B.

The reader should note the limitations of TRI data: not all toxic chemicals are included under TRI, nor are all sources of toxic chemical releases to the environment.

Environmental Distribution of TRI Releases and Transfers

Larger amounts of TRI chemicals were discharged to surface water than were emitted to air, disposed of on land, or transported off-site in 1987 (Figure 1-1, above). Almost half the total amount of TRI releases and transfers (9.6 billion pounds) was discharged to surface water. Facilities disposed of an additional 3.2 billion pounds (14 percent of the TRI total) by injecting chemicals into underground wells. Air received the next highest sum, with emissions totalling 2.7 billion pounds (12 percent), and facilities disposed of 2.5 billion pounds (11 percent) on land. The distribution changes significantly if sodium sulfate is not added in: air emissions, off-site transfers, and land releases take the lead, with 25, 24, and 23 percent of the total, respectively, while discharges to surface water drop to 5 percent and transfers to public sewage treatment plants drop to 8 percent.

Forty-three percent of the total TRI releases and transfers was discharged to surface water, 14 percent was injected in underground wells, 12 percent emitted to air, 9 percent discharged to public sewage, and 12 percent transferred to off-site facilities.

In addition to environmental releases, manufacturers discharged 1.9 billion pounds of TRI chemicals (9 percent of the TRI total) to public sewage systems and transported 2.6 billion pounds (12 percent) to

TRI DATA, EXPOSURE, AND RISK

The 18.0 billion pounds of TRI releases and 4.6 billion pounds of transfers are not an indicator of human or environmental exposure to these chemicals. Several factors should be kept in mind when considering the impact of TRI releases and transfers.

First, environmental releases do not always result in exposure. Releases to landfills or to underground injection are intended to isolate these wastes, and result in zero or low exposure unless there is an unexpected failure of the disposal technique.

Even chemicals that are not isolated in this manner require careful interpretation. TRI reveals that 2.7 billion pounds of TRI chemicals were released directly to the air, and 9.6 billion pounds to surface water in 1987. These releases cannot be equated directly to exposure, since each chemical in each individual release circumstance undergoes different transformations after release. Dilution may render exposure concentrations so small as to be of no concern. Gaseous emissions may be chemically transformed to harmless byproducts, or acidic wastewater discharges may be effectively neutralized by the receiving body of water. On the other hand, some environmental transformations lead to byproducts of even *greater* concern than the original releases. Each release scenario has its own unique characteristics.

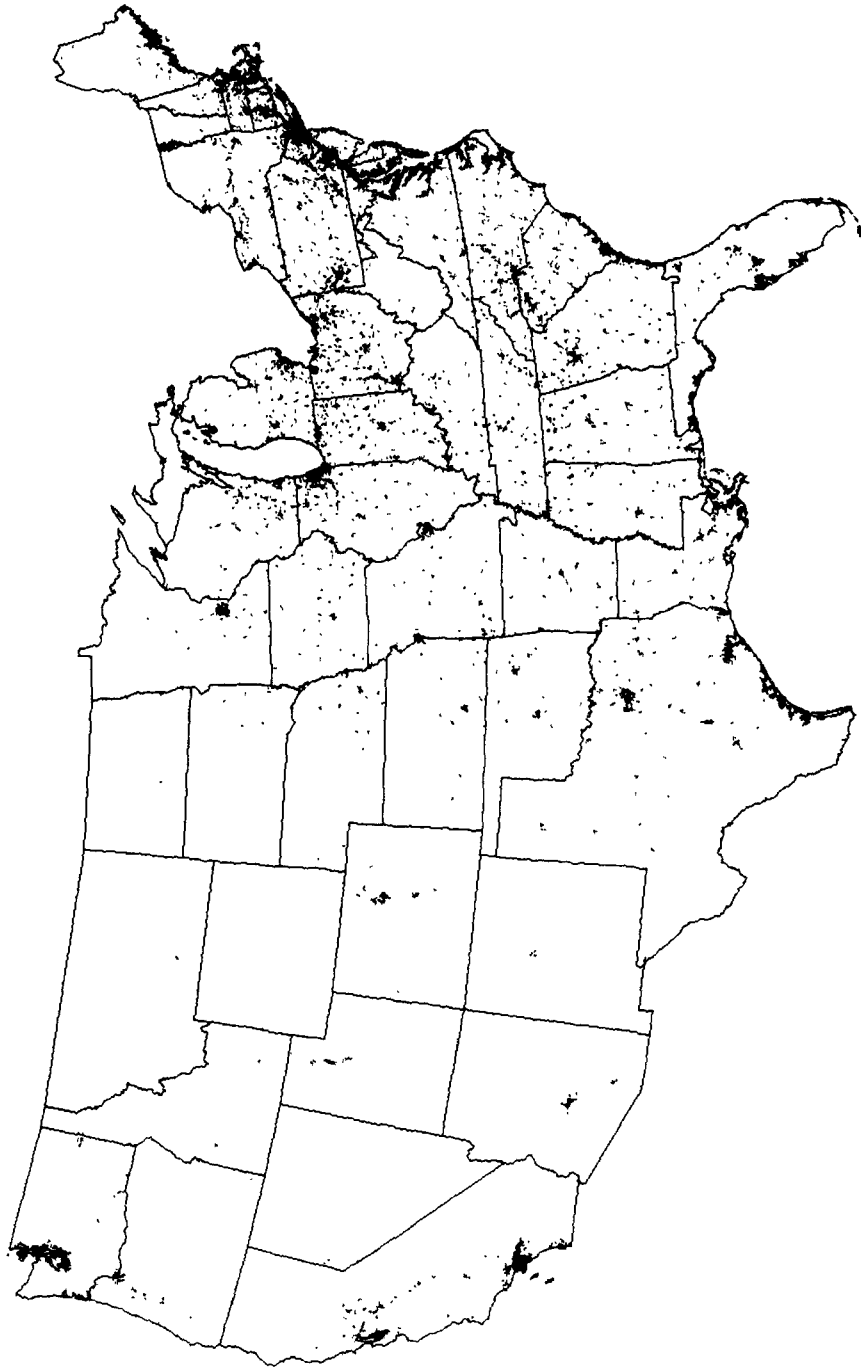
TRI chemicals were also transferred to sewage treatment plants and other off-site facilities, where they may undergo treatment (which can destroy or isolate a potentially toxic chemical) prior to ultimate disposal. The transfers also shift the location of materials, so that TRI releases generated in, say, New Jersey, may ultimately be sent to Ohio for treatment and/or disposal. A knowledge of the ultimate fate of these materials would be needed for any meaningful interpretation of potential risks.

Lastly, TRI chemicals cover a broad spectrum of toxicity concerns and total release or transfer amounts only give part of the story — a small release of a highly toxic chemical might be of much greater concern than a large release of a low-toxicity substance. In all cases, more information is needed to assess potential concerns than is provided by TRI data alone. TRI can only serve as an indicator to toxic chemicals that *may* be of concern, and hence require further attention and analysis.

Box 1-C.

off-site facilities for treatment or disposal. These facilities include private wastewater treatment plants, incinerators, and off-site landfills and underground injection wells.

Sodium sulfate played a singular role in the distribution of the TRI data, accounting for 95 percent of discharges to surface water, and more than 50 percent of discharges to underground injection and public sewage systems. Without sodium sulfate (which may be removed from the TRI list), these types of discharges would comprise a much smaller fraction of total TRI releases and transfers.



Map 1-1. Facilities Reporting to TRI Nationwide, 1987. Each dot represents one facility.

The 1987 Toxics Release Inventory

TABLE 1-1. NUMBER OF TRI FACILITIES AND AMOUNT OF RELEASES BY TYPE BY STATE, 1987
(Percentages are of total releases and transfers for the state)

STATE	TRI FACILITIES Number	TOTAL TRI AIR EMISSIONS		TOTAL TRI SURFACE WATER DISCHARGES		TOTAL TRI TRANSFERS TO PUBLIC SEWAGE	
		Pounds	Percent	Pounds	Percent	Pounds	Percent
Alabama	355	98,339,784	11.9	533,895,407	64.6	32,713,211	4.0
Alaska	7	31,707,083	85.8	5,221,865	14.1	35	0.0
American Samoa	2	56,250	78.1	15,750	21.9	0	0.0
Arizona	156	16,565,691	13.1	3,000	0.0	9,236,876	7.3
Arkansas	293	54,559,906	14.6	171,220,328	45.7	4,325,937	1.2
California	1,662	82,708,429	1.4	3,834,809,964	65.7	246,101,586	4.2
Colorado	172	11,010,395	31.2	3,325,009	9.4	3,125,396	8.8
Connecticut	383	26,078,031	30.2	25,225,312	29.2	9,544,587	11.1
Delaware	53	6,036,385	10.3	29,852,685	50.8	16,375,820	27.8
Florida	419	50,196,070	11.5	107,593,997	24.8	39,468,550	9.1
Georgia	636	93,586,285	14.1	473,506,462	71.6	47,093,822	7.1
Hawaii	33	1,064,495	21.0	2,542,000	50.2	973,250	19.2
Idaho	52	4,176,707	5.7	50,737,549	69.1	3,250,118	4.4
Illinois	1,185	99,226,761	21.2	33,437,606	7.1	199,165,360	42.5
Indiana	720	112,870,299	15.4	105,987,418	14.5	95,899,156	13.1
Iowa	310	39,238,921	54.8	15,335,547	21.4	10,090,895	14.1
Kansas	184	24,738,143	13.5	7,578,737	4.1	6,647,139	3.6
Kentucky	298	51,666,181	20.6	76,869,713	30.6	13,649,364	5.4
Louisiana	259	138,254,193	8.0	775,836,211	45.0	1,334,641	0.1
Maine	83	14,607,382	6.7	195,803,966	89.2	5,071,706	2.3
Maryland	191	20,234,753	10.4	111,795,540	57.3	47,863,355	24.5
Massachusetts	560	30,061,360	28.7	2,116,295	2.0	36,142,507	34.5
Michigan	758	116,359,932	15.7	38,127,898	5.1	38,245,470	5.1
Minnesota	301	42,095,160	29.7	15,826,354	11.2	70,020,634	49.5
Mississippi	247	57,285,976	8.7	473,882,098	72.2	9,125,709	1.4
Missouri	503	50,623,710	17.3	36,406,436	12.4	112,489,998	38.5
Montana	27	5,255,856	13.7	791,946	2.1	28,109	0.1
Nebraska	139	14,403,622	68.1	2,754,398	13.0	1,213,294	5.7
Nevada	33	742,389	6.3	0	0.0	33,814	0.3
New Hampshire	129	12,983,935	19.9	42,428,961	65.1	2,802,094	4.3
New Jersey	875	41,983,116	13.6	55,063,498	17.8	123,413,118	40.0
New Mexico	32	3,831,726	17.0	9,057	0.0	738,719	3.3
New York	765	89,399,757	27.4	56,110,261	17.2	65,294,934	20.0
North Carolina	820	94,568,576	21.4	217,090,591	49.2	54,537,779	12.4
North Dakota	28	935,275	33.4	393,600	14.0	94,217	3.4
Ohio	1,261	172,685,650	23.9	68,219,055	9.4	131,193,018	18.1
Oklahoma	193	36,445,117	28.1	65,792,624	50.7	1,692,971	1.3
Oregon	217	20,941,392	17.4	63,362,600	52.5	13,900,170	11.5
Pennsylvania	1,027	87,547,598	20.0	61,901,577	14.1	39,815,049	9.1
Puerto Rico	172	12,867,913	30.0	1,676,734	3.9	23,060,390	53.7
Rhode Island	166	5,927,841	22.3	13,187,892	49.5	2,998,055	11.3
South Carolina	394	64,215,277	12.4	340,939,102	65.8	51,090,961	9.9
South Dakota	37	2,441,359	69.4	3,698	0.1	620,208	17.6
Tennessee	503	135,010,665	22.4	196,399,204	32.6	97,149,025	16.1
Texas	999	238,817,765	8.5	659,657,602	23.6	154,293,072	5.5
Utah	102	77,327,036	31.0	133,749	0.1	2,032,004	0.8
Vermont	52	1,379,661	28.2	1,113,799	22.8	298,037	6.1
Virgin Islands	1	2,033,873	27.4	5,303,250	71.4	0	0.0
Virginia	399	132,436,076	29.8	225,383,321	50.8	55,690,097	12.5
Washington	306	40,637,496	10.0	303,684,767	74.6	4,061,980	1.0
West Virginia	107	35,564,455	20.9	87,295,714	51.2	5,179,381	3.0
Wisconsin	645	48,656,361	26.3	16,563,741	9.0	46,313,952	25.0
Wyoming	27	3,154,641	5.0	3,460,037	5.5	17,800	0.0
TOTAL	19,278	2,655,542,710	11.8	9,615,673,925	42.7	1,935,517,370	8.6

TABLE 1-1. (Continued)

STATE	TOTAL TRI ON-SITE LAND RELEASES		TOTAL TRI UNDERGROUND INJECTION		TOTAL TRI OFF-SITE TRANSFERS		TOTAL TRI RELEASES/ TRANSFERS	TOTAL TRI RELEASES/ TRANSFERS
	Pounds	Percent	Pounds	Percent	Pounds	Percent	Pounds	Rank
Alabama	98,091,692	11.9	1,443,591	0.2	62,580,627	7.6	827,064,312	4
Alaska	14,930	0.0	0	0.0	139	0.0	36,944,052	42
American Samoa	0	0.0	0	0.0	0	0.0	72,000	53
Arizona	97,102,866	77.0	0	0.0	3,163,551	2.5	126,071,984	31
Arkansas	108,534,294	29.0	13,016,449	3.5	23,124,550	6.2	374,781,464	18
California	47,693,392	0.8	1,530,850,645	26.2	97,644,358	1.7	5,839,808,374	1
Colorado	12,547,494	35.5	1,170	0.0	5,321,533	15.1	35,330,997	43
Connecticut	1,848,676	2.1	0	0.0	23,677,774	27.4	86,374,380	34
Delaware	2,565,876	4.4	250	0.0	3,987,692	6.8	58,818,708	39
Florida	190,827,201	43.9	29,437,389	6.8	17,162,515	3.9	434,685,722	16
Georgia	14,969,473	2.3	19,500	0.0	32,555,326	4.9	661,730,868	8
Hawaii	237,342	4.7	216,140	4.3	30,226	0.6	5,063,453	49
Idaho	14,988,307	20.4	0	0.0	259,307	0.4	73,411,988	35
Illinois	11,209,153	2.4	14,221,970	3.0	111,556,134	23.8	468,816,984	12
Indiana	246,523,580	33.7	63,356,466	8.7	107,092,085	14.6	731,729,004	6
Iowa	768,722	1.1	0	0.0	6,149,084	8.6	71,583,169	36
Kansas	1,058,669	0.6	91,067,410	49.7	52,300,709	28.5	183,390,807	27
Kentucky	4,028,637	1.6	25,000,250	10.0	79,727,997	31.8	250,942,142	22
Louisiana	154,894,837	9.0	553,820,180	32.1	101,793,171	5.9	1,725,933,233	3
Maine	2,037,139	0.9	0	0.0	2,040,371	0.9	219,560,564	24
Maryland	4,318,725	2.2	750	0.0	11,035,136	5.7	195,248,259	25
Massachusetts	3,575,212	3.4	250	0.0	32,931,176	31.4	104,826,800	33
Michigan	3,979,327	0.5	6,472,752	0.9	539,530,650	72.6	742,716,029	5
Minnesota	1,722,105	1.2	250	0.0	11,833,822	8.4	141,498,325	29
Mississippi	15,252,731	2.3	46,433,140	7.1	54,106,141	8.2	656,085,795	9
Missouri	56,439,000	19.3	1,001,450	0.3	35,466,064	12.1	292,426,658	21
Montana	32,223,598	83.8	0	0.0	138,140	0.4	38,437,649	41
Nebraska	349,910	1.7	0	0.0	2,428,365	11.5	21,149,589	46
Nevada	10,817,492	92.2	0	0.0	141,555	1.2	11,735,250	47
New Hampshire	666,529	1.0	0	0.0	6,249,760	9.6	65,131,279	37
New Jersey	5,312,503	1.7	780	0.0	82,811,996	26.8	308,585,011	20
New Mexico	17,307,456	76.8	0	0.0	641,055	2.8	22,528,013	45
New York	17,598,716	5.4	500	0.0	97,670,612	30.0	326,074,780	19
North Carolina	30,157,949	6.8	250	0.0	44,990,734	10.2	441,345,879	14
North Dakota	1,100,500	39.3	0	0.0	279,990	10.0	2,803,582	52
Ohio	47,664,590	6.6	71,850,645	9.9	232,280,058	32.1	723,893,016	7
Oklahoma	2,482,881	1.9	7,171,133	5.5	16,196,697	12.5	129,781,423	30
Oregon	13,998,763	11.6	0	0.0	8,401,643	7.0	120,604,568	32
Pennsylvania	70,957,429	16.2	74,000	0.0	177,338,841	40.5	437,634,494	15
Puerto Rico	184,150	0.4	988	0.0	5,137,365	12.0	42,927,540	40
Rhode Island	69,009	0.3	0	0.0	4,439,825	16.7	26,622,622	44
South Carolina	8,994,959	1.7	750	0.0	52,886,551	10.2	518,127,600	11
South Dakota	9	0.0	0	0.0	452,952	12.9	3,518,226	51
Tennessee	20,550,544	3.4	124,406,900	20.7	28,631,687	4.8	602,148,025	10
Texas	835,087,965	29.8	630,223,666	22.5	281,688,463	10.1	2,799,768,533	2
Utah	165,467,430	66.3	3	0.0	4,782,932	1.9	249,743,154	23
Vermont	168,696	3.5	0	0.0	1,929,473	39.5	4,889,666	50
Virgin Islands	87,505	1.2	0	0.0	0	0.0	7,424,628	48
Virginia	6,949,712	1.6	250	0.0	23,590,468	5.3	444,049,924	13
Washington	25,105,014	6.2	500	0.0	33,588,830	8.3	407,078,587	17
West Virginia	11,638,215	6.8	1,719,219	1.0	29,174,069	17.1	170,571,053	28
Wisconsin	7,535,521	4.1	1,500	0.0	65,886,063	35.6	184,957,138	26
Wyoming	24,183,539	38.6	30,651,671	49.0	1,129,103	1.8	62,596,791	38
TOTAL	2,451,889,964	10.9	3,242,462,757	14.4	2,617,957,365	11.6	22,519,044,091	

A total of 19,278 facilities reported to TRI. More facilities reported from California than from any other state.

TRI Facilities

A total of 19,278 manufacturing facilities reported to TRI from all 50 states, Puerto Rico, the U.S. Virgin Islands, and American Samoa (Map 1-1). No facilities reported from the District of Columbia or from the Commonwealth of the Northern Mariana Islands.

More than half of the manufacturers were located in ten states. California had the largest number of TRI facilities – 1,662 facilities. Each of the top ten states had more than 700 facilities reporting, for a total of 10,072 facilities (Table 1-1).

Geographical Distribution of TRI Releases and Transfers

California, Texas, and Louisiana had the largest total TRI releases and transfers.

The 5.8 billion pounds of releases and off-site transfers from California dwarfed those of any other state, accounting for 26 percent of the TRI total for the nation (Map 1-2). However, a disproportionately large amount of California's total was due to sodium sulfate releases from a single facility in the state which discharged 3.7 billion pounds of this chemical to surface water, and an additional 1.5 billion pounds by underground injection. (Indeed, this single facility was responsible

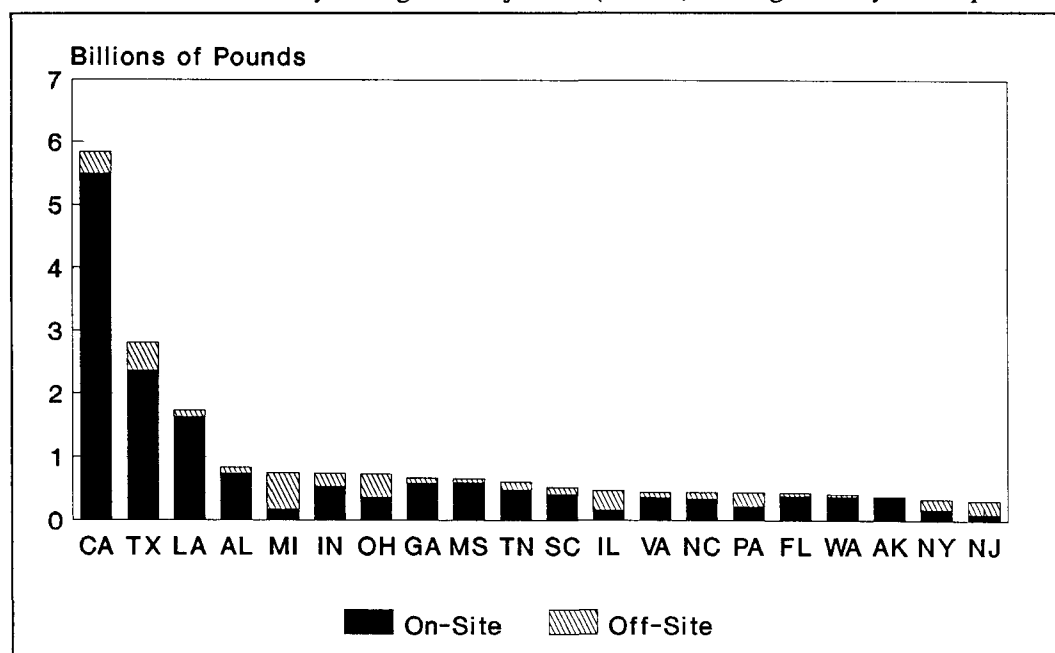
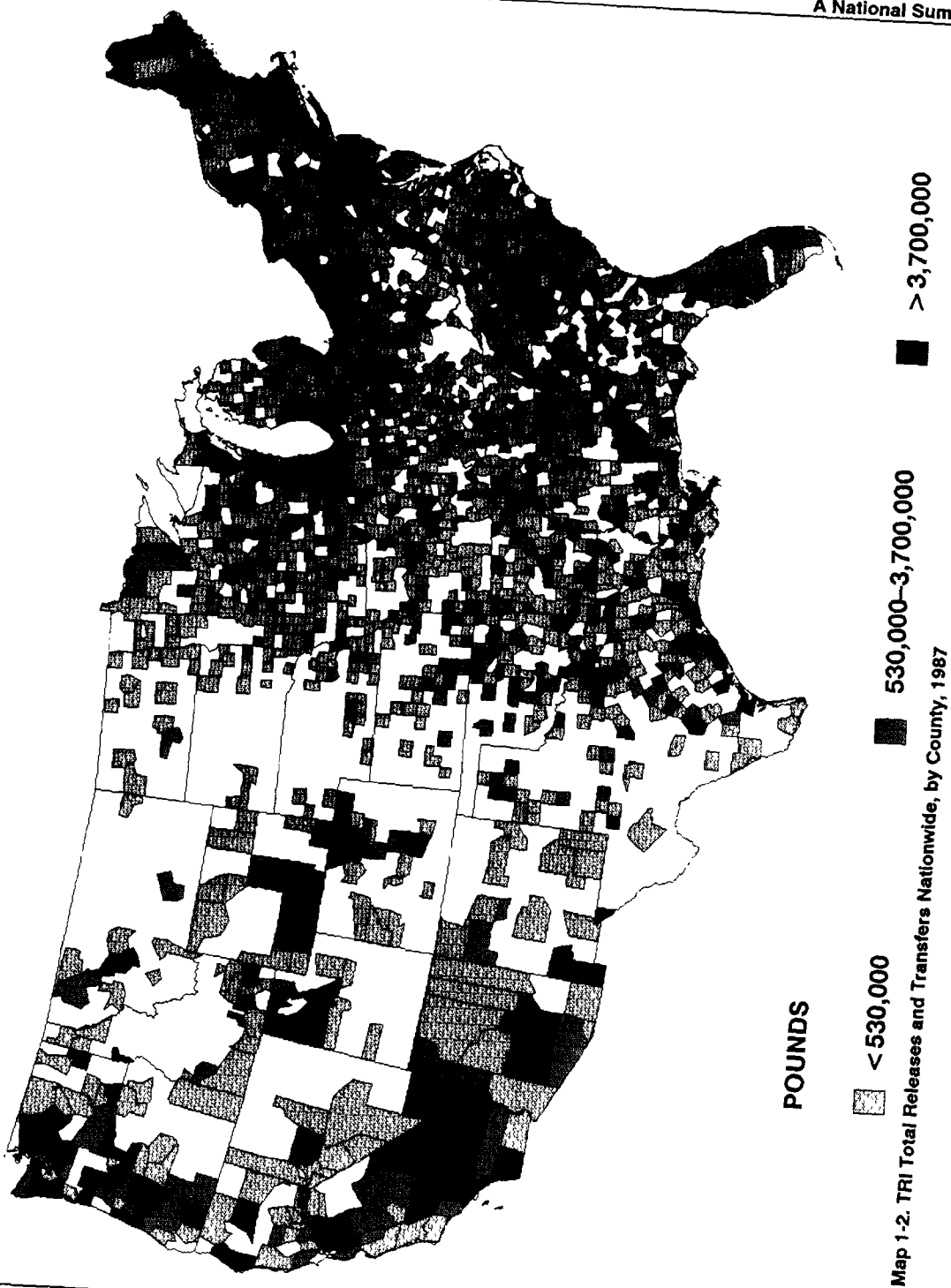


Figure 1-2.
The 20 States with the Largest Total Releases and Transfers, 1987.



The 1987 Toxics Release Inventory

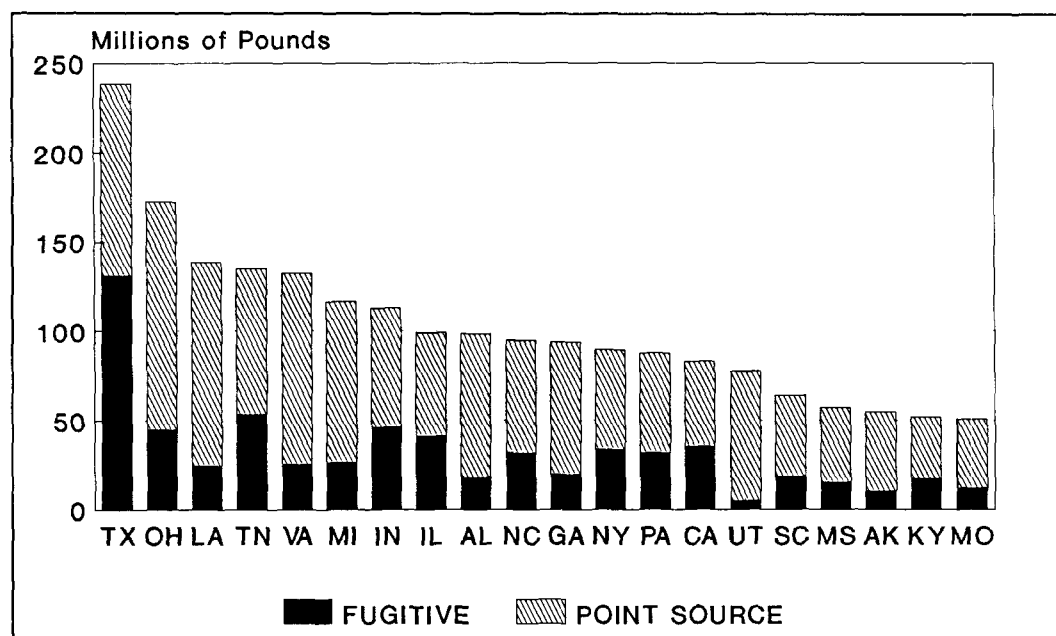


Figure 1-3.
The 20 States with the Largest Total Air Emissions of TRI Chemicals, 1987.

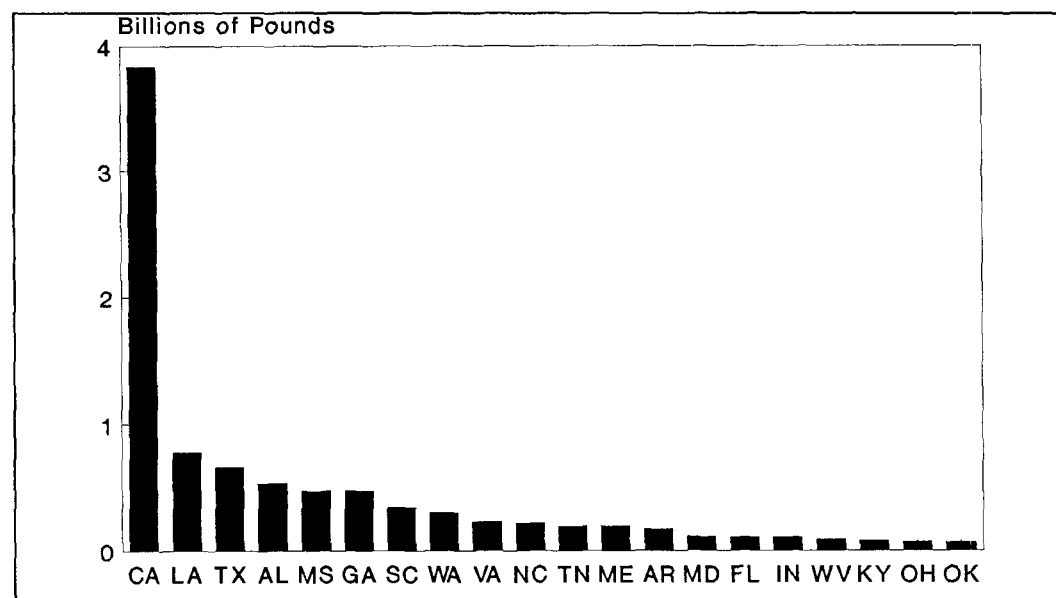


Figure 1-4.
The 20 States with the Largest Surface Water Discharges of TRI Chemicals, 1987.

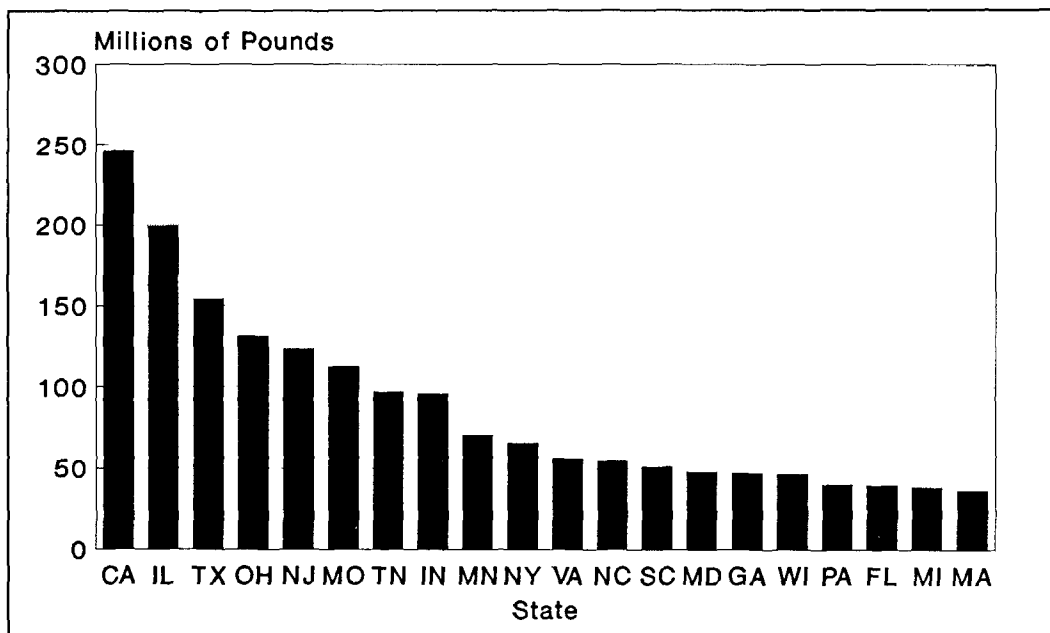


Figure 1-5.
The 20 States with the Largest Discharges of TRI Chemicals to Public Sewage Systems, 1987.

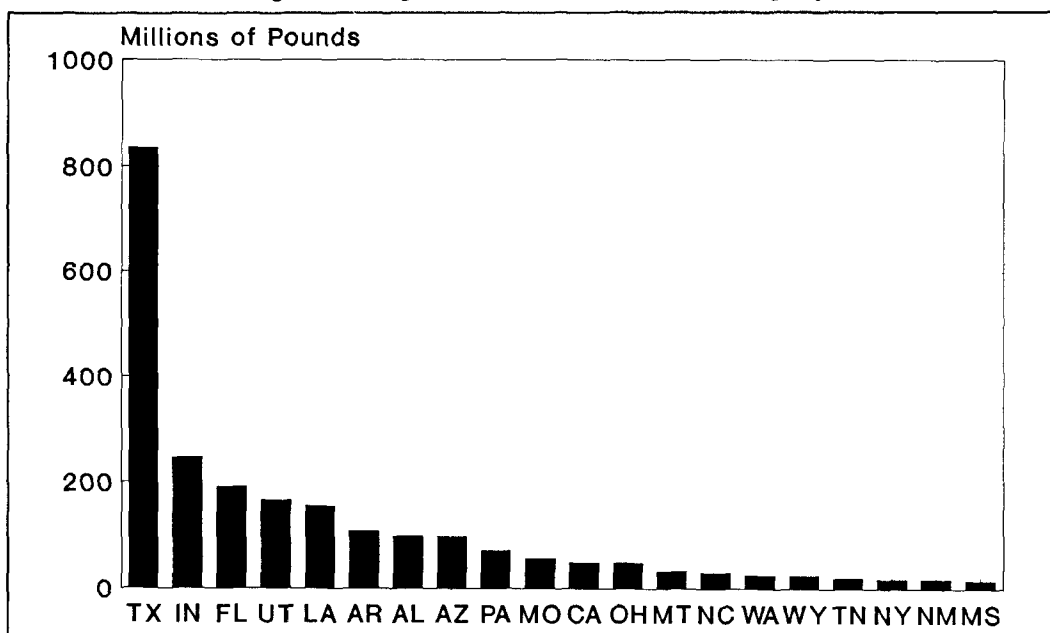


Figure 1-6.
The 20 States with the Largest On-Site Land Disposal of TRI Chemicals, 1987.

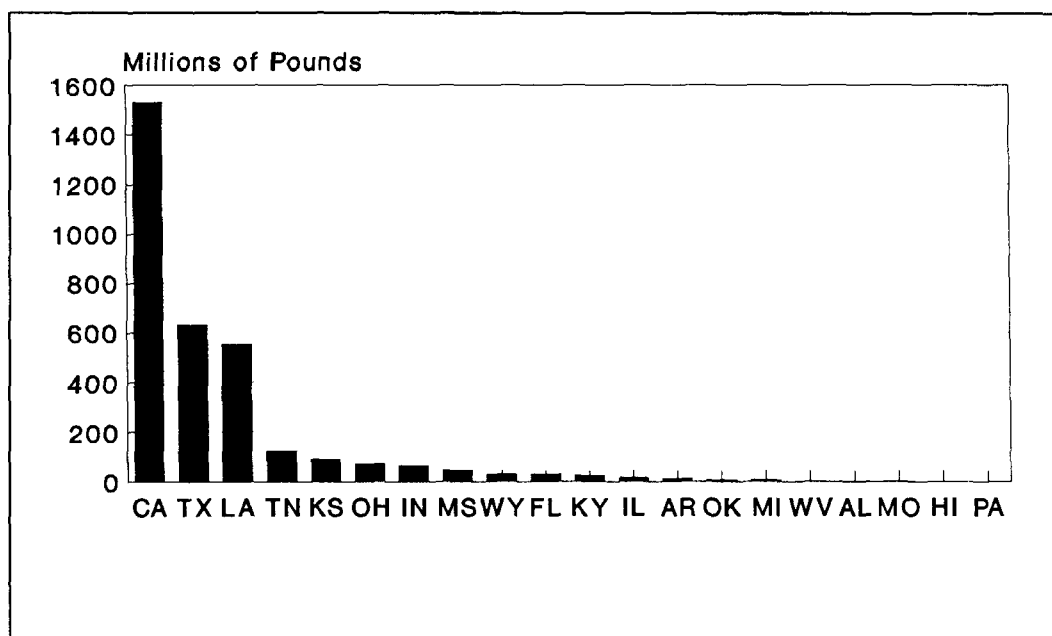


Figure 1-7.
The 20 States with the Largest Underground Injections of TRI Chemicals, 1987.

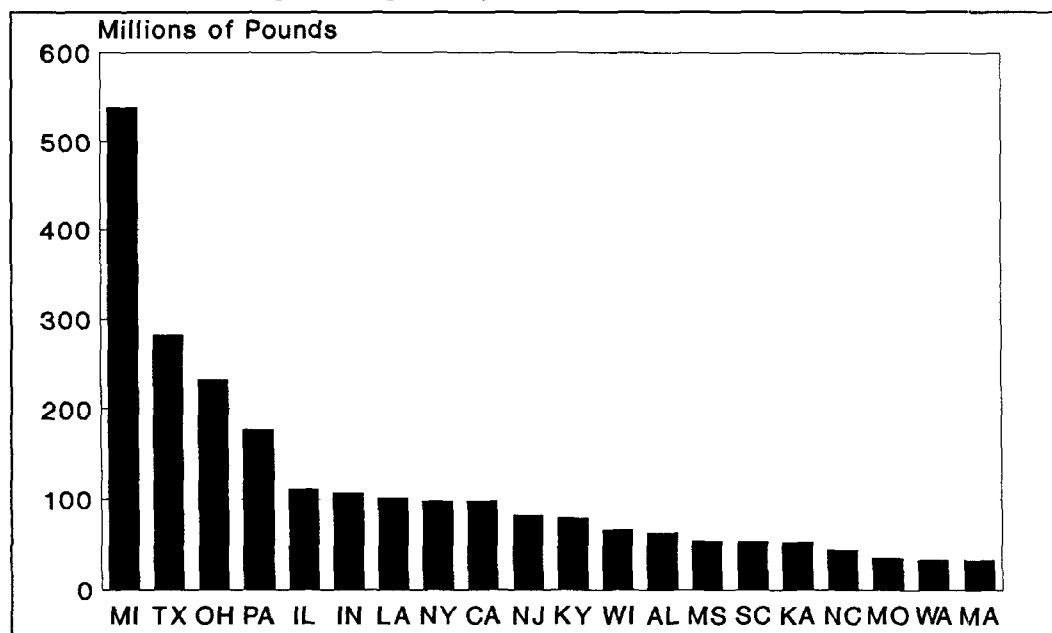


Figure 1-8.
The 20 States with the Largest Total Off-Site Transfers of TRI Chemicals, 1987. (By state from which off-site transfers originated.)

for nearly 45 percent of the nation's total sodium sulfate releases and transfers.)

Texas and Louisiana ranked second and third for total TRI releases and transfers, with 2.8 and 1.7 billion pounds, respectively (Figure 1-2). Sodium sulfate did not account for a particularly large share of the totals for either state.

Rankings amongst the states changed somewhat according to the type of release or transfer (Figures 1-3, 1-4, 1-5, 1-6, 1-7, and 1-8). However, Texas, Louisiana, and California were generally among the top five states for nearly every type of release or transfer. Two notable exceptions were that California ranked only 14th for total air emissions, and Louisiana was ranked 41st for discharges to public sewage systems.

Michigan facilities transported by far the largest share of TRI chemicals to off-site facilities, accounting for over one fifth of the total amount of wastes transported (Figure 1-8, above). Over half of the state's total was composed of aluminum oxide transported off-site by a single facility.

Distribution of TRI Releases and Transfers in States

States differ markedly in the environmental distribution of their TRI releases and transfers (Table 1-1, above). In California, surface water discharges and underground injection dominated, together accounting for 93 percent of the state's total. In Maine, surface water discharges alone accounted for nearly 90 percent of that state's TRI total. In Western states such as Nevada, New Mexico, and Utah, the largest share of TRI chemicals was disposed of on land (92 percent, 77 percent, and 66 percent of the state total, respectively).

Michigan facilities transferred 73 percent of their TRI total off-site; Pennsylvania and Vermont followed with 41 percent and 39 percent, respectively. On the other hand, only two percent of California's TRI total, and six percent of Louisiana's were transferred to off-site facilities, the remainder being on-site releases.

Industrial Patterns of Releases and Transfers

The Chemical industry generated 54 percent of the total TRI releases and transfers.

The Chemical and Allied Products industry produced more TRI releases and transfers than any other industry in 1987, with a total of 12.1 billion pounds or 54 percent of the TRI total for all industries (Table 1-2, Figure 1-9). Chemical manufacturers produced more releases and transfers than any other industry in each of the following categories: air emissions, discharges to surface water, underground injection, and transfers to public sewage systems. Two other industries reported TRI totals of more than one billion pounds: Paper Products and Primary Metals. Together, these three industries generated 78 percent of all releases and transfers reported under TRI.

The Chemical industry discharged 48 percent of its total TRI releases and transfers to surface water.

Industries generated distinct patterns of TRI releases and transfers. Almost half of the Chemical industry's total was releases to surface water; releases to underground injection comprised an additional 24 percent. Surface water discharges also accounted for a large fraction (78 percent) of the Paper industry's total releases and transfers. The Primary Metals industry released 1.4 billion pounds of chemicals to land and transferred 961 million pounds off-site, accounting for 76 percent of this industry's releases and transfers. The Transportation Equipment industry, although accounting for only 1.5 percent of the

TABLE 1-2. AMOUNT OF TRI RELEASES AND TRANSFERS BY TYPE BY INDUSTRY, 1987

SIC CODE	INDUSTRY	TRI FACILITIES	TOTAL AIR RELEASES		SURFACE WATER		TRANSFERS TO PUBLIC SEWAGE	
		Number	Pounds	Percent	Pounds	Percent	Pounds	Percent
20	Food Products	1,576	17,337,833	6.04	30,560,639	10.65	205,826,534	71.71
21	Tobacco Manufacturers	24	7,566,510	72.32	132,545	1.27	2,293,820	21.93
22	Textile Mill Products	469	38,305,895	10.95	182,363,832	52.12	119,540,333	34.16
23	Apparel	37	2,295,032	48.11	42,810	0.90	2,336,808	48.99
24	Lumber and Wood Products	644	28,879,647	74.75	1,001,064	2.78	1,545,461	4.30
25	Furniture and Fixtures	332	50,928,135	85.28	47,984	0.08	853,889	1.43
26	Paper Products	663	232,639,586	8.29	2,183,493,703	77.78	184,880,068	6.59
27	Printing, Publishing	287	54,122,107	85.99	3,521	0.01	3,444,032	5.47
28	Chemical Products	3,849	946,395,722	7.83	5,835,403,944	48.27	784,202,550	6.49
29	Petroleum Refining	343	79,137,824	10.38	366,051,900	48.02	50,530,645	6.63
30	Rubber and Plastic Products	1,125	143,760,863	51.88	54,077,618	19.52	48,224,867	17.40
31	Leather Products	117	14,098,158	27.07	1,959,658	3.76	31,984,904	61.41
32	Stone, Clay, Glass Products	629	27,035,373	23.11	1,322,017	1.13	7,146,833	6.11
33	Primary Metals	1,305	234,283,732	9.03	105,944,217	4.09	180,432,302	6.96
34	Fabricated Metals	2,393	109,921,878	35.89	9,078,259	2.96	76,585,656	25.00
35	Machinery, except Electrical	787	49,698,725	50.15	4,439,271	4.48	10,528,549	10.63
36	Electric and Electronic Equip.	1,426	110,349,790	37.14	13,080,342	4.40	85,642,196	28.82
37	Transportation Equipment	908	213,563,972	64.25	3,878,314	1.17	18,199,214	5.48
38	Measuring, Photographic Goods	306	46,331,167	57.10	3,153,101	3.89	9,766,977	12.04
39	Misc. Manufacturing	337	24,865,197	68.45	264,802	0.73	2,103,483	5.79
	Multiple SIC codes in 20 - 39	1,317	211,289,810	12.36	799,136,129	46.73	100,432,157	5.87
	No SIC codes in 20 - 39	404	14,735,754	9.96	20,237,455	13.68	9,015,992	6.09
	GRAND TOTAL	19,278	2,655,542,710	11.79	9,615,673,925	42.70	1,935,517,370	8.60

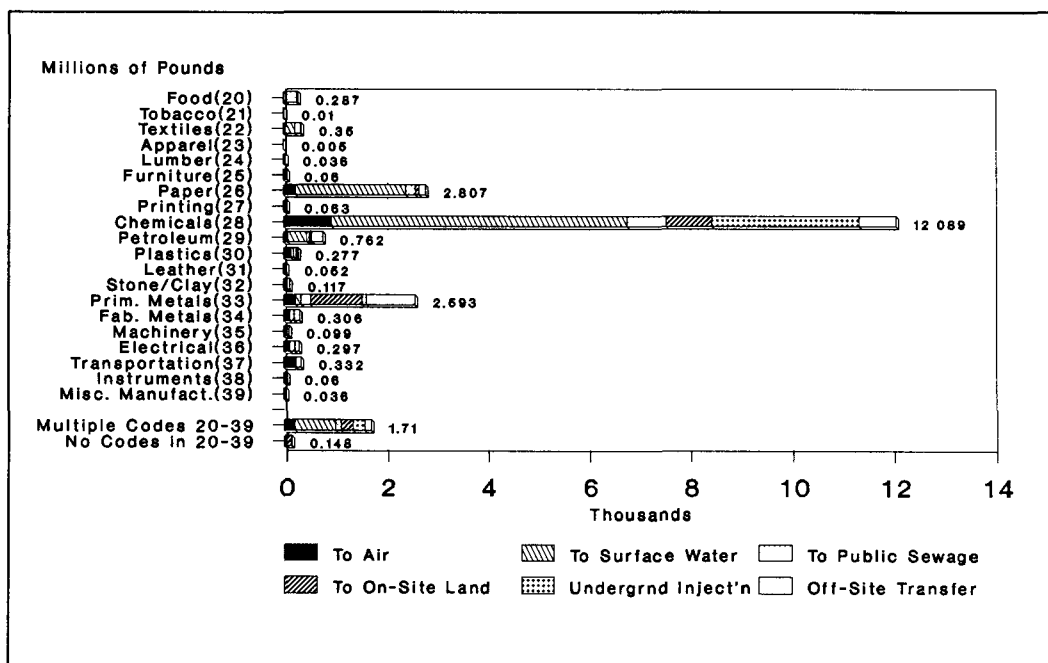


Figure 1-9. Distribution of TRI Total Releases and Transfers by Industry, 1987. Industries are grouped according to Standard Industrial Classification (SIC) Codes.

TABLE 1-2 (Continued)

INDUSTRY	TOTAL ON-SITE LAND		UNDERGROUND INJECTION		TRANSFERS OFF-SITE		TOTAL TRI RELEASES/ TRANSFERS	TOTAL RELEASES/ TRANSFER RANK
	Pounds	Percent	Pounds	Percent	Pounds	Percent	Pounds	
Food Products	23,018,190	8.02	190,566	0.07	10,077,922	3.51	287,011,684	10
Tobacco Manufacturers	10,810	0.10	0	0.00	458,196	4.38	10,461,881	21
Textile Mill Products	642,327	0.18	0	0.00	9,058,955	2.59	349,911,142	6
Apparel	1,500	0.03	0	0.00	94,221	1.98	4,770,371	22
Lumber and Wood Products	2,625,119	7.30	0	0.00	3,909,453	10.87	35,960,744	20
Furniture and Fixtures	28,105	0.05	0	0.00	7,857,362	13.16	59,715,475	17
Paper Products	77,350,923	2.76	30,894	0.00	129,014,310	4.60	2,807,409,484	2
Printing, Publishing	2,597	0.00	0	0.00	5,364,131	8.52	62,936,388	16
Chemical Products	900,323,396	7.45	2,902,166,936	24.01	720,337,123	5.96	12,088,829,671	1
Petroleum Refining	39,701,782	5.21	21,174,667	2.78	205,764,651	26.99	762,361,469	5
Rubber and Plastic Products	806,162	0.29	49,800	0.02	30,177,303	10.89	277,096,613	11
Leather Products	166,320	0.32	0	0.00	3,878,288	7.45	52,087,328	18
Stone, Clay, Glass Products	25,056,647	21.42	6,326,300	5.41	50,081,467	42.82	116,968,737	13
Primary Metals	1,021,550,898	39.39	90,418,540	3.49	960,608,352	37.04	2,593,238,041	3
Fabricated Metals	4,970,842	1.62	1,453,671	0.47	104,277,700	34.05	306,289,006	8
Machinery, except Electrical	660,719	0.67	0	0.00	33,764,108	34.07	99,091,372	14
Electric and Electronic Equip	7,315,930	2.46	2,437,306	0.82	78,291,668	26.35	297,117,232	9
Transportation Equipment	5,397,988	1.62	47,339	0.01	91,310,180	27.47	332,397,007	7
Measuring, Photographic Good	164,116	0.20	0	0.00	21,725,976	26.78	81,141,337	15
Misc. Manufacturing	248,233	0.68	250	0.00	8,842,508	24.34	36,324,473	19
Multiple SIC codes in 20 - 39	249,504,529	14.59	217,854,136	12.74	131,767,953	7.71	1,709,984,714	4
No SIC codes in 20 - 39	92,342,831	62.42	312,352	0.21	11,295,538	7.64	147,939,922	12
GRAND TOTAL	2,451,889,964	10.89	3,242,462,757	14.40	2,617,957,365	11.63	22,519,044,091	

TRI total, had disproportionately large air emissions and contributed 8 percent of total TRI air emissions for all industries.

Over half of the total TRI releases and transfers was generated by facilities that engaged only in manufacturing chemicals.

Facilities reporting *manufacturing* as their sole activity for TRI chemicals (as opposed to *processing*, or *other uses* such as equipment cleaning) comprised only 1.3 percent of TRI facilities nationwide, but accounted for 12 billion pounds of releases and transfers — 56 percent of the TRI total.

Industries also differed in their patterns of on-site releases/off-site transfers. The Primary Metals industry transferred 37 percent of its TRI total off-site; the Chemical industry only six percent. Together, these two industries accounted for 64 percent of total off-site transfers for all industries reporting under TRI.

The Chemical industry accounted for 41 percent of all TRI discharges to public sewage treatment plants.

The Chemical industry accounted for 41 percent (784 million pounds) of all TRI chemicals discharged to public sewage treatment plants. Facilities in each of four additional industries discharged more than 100 million pounds of TRI chemicals to public sewage systems: Food and Kindred Products with 11 percent (206 million pounds); Paper Products with ten percent (185 million pounds); Primary Metals with nine percent (180 million pounds); and Textiles with six percent (120 million pounds). Discharges to public sewage systems from these five industries made up 76 percent of the total.

The Primary Metals industry transported 961 million pounds of TRI chemicals to off-site facilities, which accounted for the largest share (37 percent) of off-site transfers. The Chemical industry ranked second for off-site transfers, transporting 720 million pounds, or 28 percent of the total.

Off-site Transfers: The Interstate Transport of TRI Wastes

While transfers to public sewage systems are generally local, other off-site transfers to treatment and disposal facilities may cross state lines. In 1987, over one quarter of all reported off-site transfers (731 million pounds) were transported to facilities across state lines (Figure 1-10). Ohio facilities received 13 percent of all out-of-state transfers (92 million pounds), the largest share for any state.² Louisiana, Indiana, New Jersey, Pennsylvania, and Michigan also received large amounts of off-site transfers from out-of-state facilities, each accepting over 40 million pounds of off-site transfers.

One quarter of all reported off-site transfers were transported to off-site facilities across states lines.

Facilities were not required to report transfers of TRI chemicals sent off-site for recycling. Some facilities appear to have reported such data, however, and these are included in the off-site transfer totals.

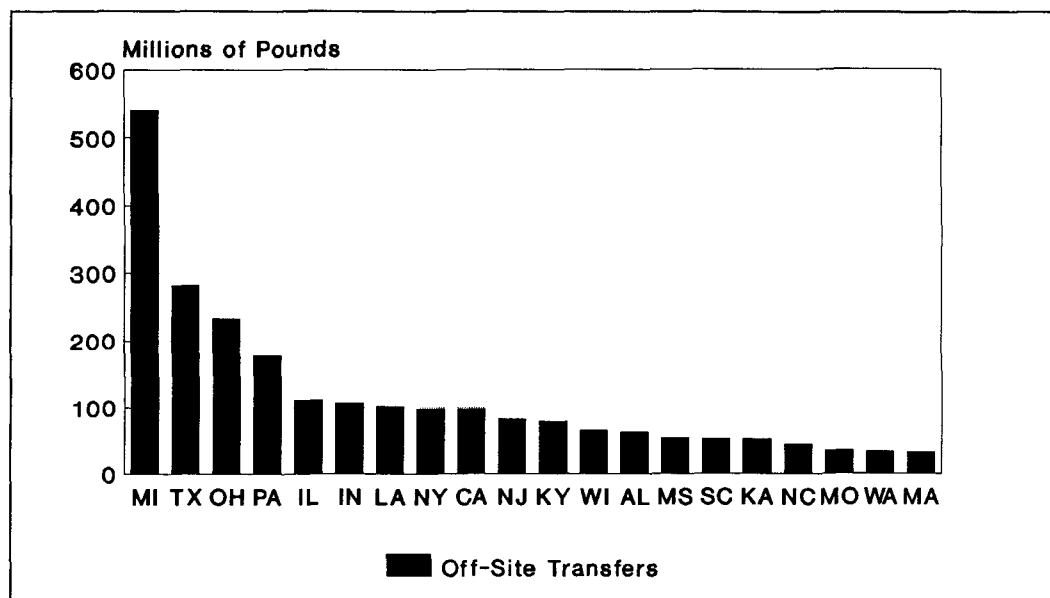


Figure 1-10. Transfers of TRI Chemicals Across State Lines, 1987. Amounts listed for states receiving transfers from out-of-state.

² Transfer locations were not identified for 102 million pounds (four percent) of the chemical wastes transferred off-site, so it cannot be determined what fraction, if any, of this amount was transported to out-of-state locations.

Chemicals with the Largest Releases and Transfers

Twenty-five chemicals accounted for 94 percent of the total TRI releases and transfers in 1987.

The 25 chemicals with the largest TRI totals accounted for 94 percent of all releases and transfers (Table 1-3). As mentioned earlier, 12.1 billion pounds of sodium sulfate dominated TRI totals, accounting for 54 percent of all releases and transfers. Aluminum oxide was the only other chemical with a TRI total of greater than one billion pounds, accounting for 20 percent of the TRI releases and transfers. Both chemicals are under review by EPA and may be removed from the TRI list of reportable chemicals due to a lack of significant toxicity concerns.

TABLE 1-3. THE 25 TRI CHEMICALS WITH THE LARGEST TOTAL RELEASES AND TRANSFERS BY MEDIA, 1987

Rank	CHEMICAL NAME	TOTAL TRI RELEASE/ TRANSFER Pounds	TOTAL DISCHARGES TO SURFACE WATERS Pounds	TOTAL TRANSFERS TO PUBLIC SEWAGE Pounds	TOTAL ON-SITE RELEASES TO LAND Pounds	TOTAL UNDERGROUND INJECTION Pounds	TOTAL OFF-SITE TRANSFERS Pounds	TOTAL RELEASES/ TRANSFERS Pounds	Percent
1	SODIUM SULFATE (SOLUTION)	0	9,061,039,211	1,052,044,568	91,199,023	1,738,973,178	130,606,774	12,079,565,192	53.64
2	ALUMINUM OXIDE	83,845,554	36,101,026	2,978,518	1,393,735,259	56,724,250	861,591,039	2,434,973,644	10.81
3	AMMONIUM SULFATE (SOLUTION)	6,381,186	90,169,835	189,392,111	7,249,407	611,231,000	13,419,977	917,843,516	4.08
4	HYDROCHLORIC ACID	52,512,848	13,674,536	57,602,155	12,114,031	413,453,666	107,367,120	656,744,056	2.92
5	SULFURIC ACID	19,406,368	77,533,817	100,123,426	79,173,009	135,999,729	230,515,099	642,751,448	2.85
6	SODIUM HYDROXIDE (SOLUTION)	7,880,603	78,730,126	239,349,220	131,481,032	34,336,640	135,071,893	626,849,514	2.78
7	AMMONIA	318,028,225	31,641,355	36,650,299	4,967,305	47,783,820	5,413,863	444,484,887	1.97
8	METHANOL	196,038,365	24,909,084	92,511,680	14,702,600	19,582,067	71,802,772	419,548,588	1.86
9	TOLUENE	258,279,298	339,959	3,418,364	1,747,264	1,520,943	79,259,364	344,565,192	1.53
10	PHOSPHORIC ACID	1,615,570	128,832,077	15,425,906	187,196,716	73,704	10,778,338	343,922,311	1.53
11	ACETONE	178,348,341	2,032,678	14,057,015	258,979	2,280,943	37,614,073	234,592,029	1.04
12	XYLENE (MIXED ISOMERS)	137,243,778	473,529	4,102,755	644,953	586,751	74,612,447	217,664,213	0.97
13	METHYL ETHYL KETONE	145,810,523	75,691	612,678	88,763	75,250	46,085,612	192,748,517	0.86
14	1,1,1-TRICHLOROETHANE	151,233,854	40,700	418,360	199,061	28,325	29,998,240	181,918,560	0.81
15	COPPER	2,370,791	276,053	537,980	138,313,940	452,890	35,926,437	177,878,091	0.79
16	ZINC COMPOUNDS	5,753,287	1,630,588	1,734,423	106,238,413	707,666	60,512,500	176,576,887	0.78
17	DICHLOROMETHANE	118,439,343	369,150	1,827,208	67,621	560,000	31,225,718	152,289,040	0.68
18	CARBON DISULFIDE	136,167,830	22,791	180,511	3,480	89,500	251,400	136,715,512	0.61
19	CHLORINE	110,349,352	10,975,651	6,552,692	1,529,801	84,439	1,743,642	131,235,577	0.58
20	AMMONIUM NITRATE (SOLUTION)	7,545,171	11,716,296	9,804,639	15,076,212	58,565,000	12,140,708	114,848,028	0.51
21	MANGANESE COMPOUNDS	2,043,072	669,597	599,083	33,932,193	10,800,800	66,692,040	114,736,785	0.51
22	NITRIC ACID	7,204,493	16,642,456	30,900,534	8,914,511	9,187,612	25,287,175	98,136,781	0.44
23	ZINC (FUME OR DUST)	4,270,474	454,434	1,777,237	44,081,364	189,574	40,574,728	91,347,809	0.41
24	ETHYLENE	60,792,720	12,686	250	7,436	0	8,658,936	69,472,028	0.31
25	FREON 113	53,105,656	36,587	105,101	22,582	617	9,090,684	62,361,207	0.28
SUBTOTAL		2,064,666,702	9,588,399,925	1,862,504,751	2,272,944,935	3,143,288,384	2,126,260,597	21,063,767,712	93.54
TOTAL FOR ALL OTHERS		590,876,008	27,274,000	73,012,619	178,945,029	99,174,373	491,696,768	1,455,276,379	6.46
GRAND TOTAL		2,655,542,710	9,615,673,925	1,935,517,370	2,451,889,964	3,242,462,757	2,617,957,365	22,519,044,091	100.00

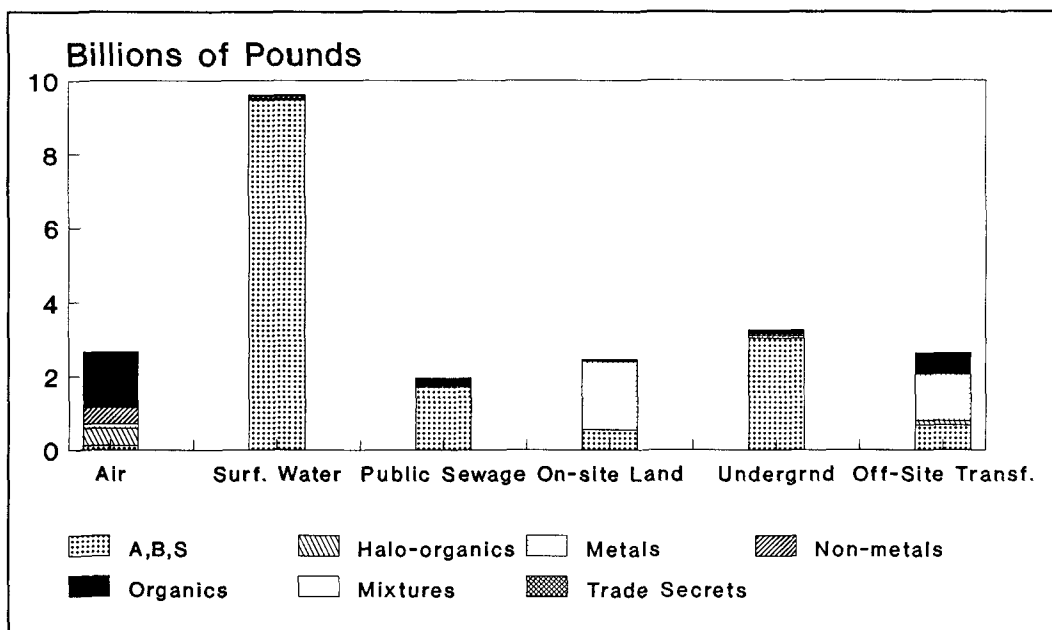


Figure 1-11.
TRI Releases and Transfers by Chemical Class, 1987.

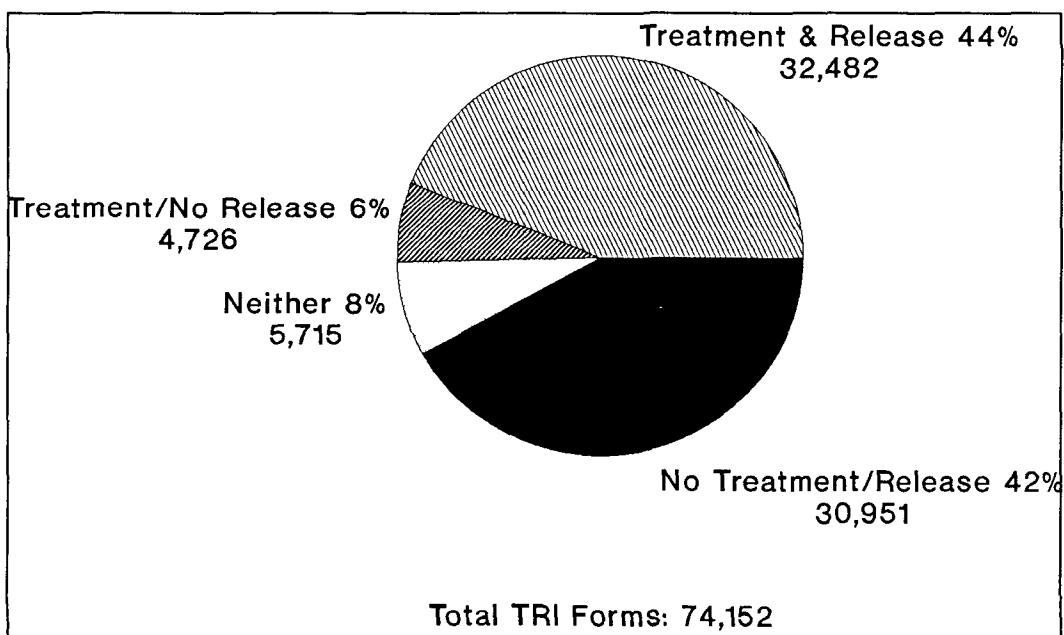


Figure 1-12.
TRI Forms Reporting Waste Treatment and Releases to the Environment, 1987.

Six chemicals had total releases and transfers greater than 500 million pounds.

Four additional chemicals had TRI totals greater than 500 million pounds: ammonium sulfate, hydrochloric acid, sulfuric acid, and sodium hydroxide. No TRI chemicals beyond the top 25 accounted for even 0.3 percent of the TRI total.

TRI chemicals played distinctly different roles in each type of release or transfer. Aluminum oxide accounted for the largest proportion of on-site land disposal (55 percent) and off-site transfers (33 percent). Sodium sulfate, not surprisingly, dominated releases in several categories: surface water discharges (94 percent), discharges to public sewage systems (54 percent), and underground injection (54 percent). Toluene, acetone and trichloroethane each accounted for more than 10 percent of total air emissions of TRI chemicals.

Grouping the 328 TRI chemicals and chemical categories into five classes—**acids/bases/salts**, **organics (non-halogenated)**, **halogenated organics**, **metals and metal compounds**, and **non-metallic inorganics**—shows how releases and transfers vary among chemicals (Figure 1-11). Discharges to surface water are dominated by the acids/bases/salts class, while metals are a large portion of the TRI on-site land releases. Air emissions and off-site transfers are more evenly divided among these classes.

Waste Treatment

Half of all TRI facilities reported treating their chemical wastes.

Just over one half (9,725) of the TRI facilities indicated treating chemical wastes on-site before releasing or transferring them off-site. Six percent of all TRI forms reported treating wastes but not releasing them, which suggests that waste treatment for these chemicals was 100 percent successful (Figure 1-12).

On-site waste treatment was reported for 262 (96 percent) of the 272 chemicals and chemical categories for which TRI forms were received. No facilities reported on-site treatment for 12 of the chemicals.

The percentage of facilities reporting on-site waste treatment for individual chemicals varied. For example, 79 percent of the facilities that reported for nitric acid indicated that they treated wastes containing this chemical. However, only 25 percent of the facilities reporting 1,1,1-trichloroethane releases or transfers indicated on-site treatment of wastes containing it.

Waste Minimization

Eleven percent of TRI facilities (2,090 out of 19,278) reported attempts to minimize TRI chemical wastes in the *optional* waste minimization section on the TRI form. These facilities submitted six percent of the total TRI forms for 1987. A subset³ of 802 facilities was examined to detail waste minimization between 1986 and 1987. The subset reported generating 121 million pounds of waste in 1986 and only 69 million pounds in 1987, for an overall reduction of 52.4 million pounds (43 percent.) Factoring in the impact of changes in production levels, overall reductions appear even larger – more than 60 percent. Facilities in Michigan, Texas, and Louisiana reported the most waste minimization (11.5, 8.9 and 4.5 million pounds respectively). **On-site recycle/reuse** achieved the largest reductions of waste (21.1 million pounds), for an overall 50 percent reduction. **Self-initiated reviews** were cited most often as the reason for pursuing waste minimization; **regulatory requirements** were cited infrequently (Figure 1-13).

Eleven percent of TRI facilities reported attempts to minimize TRI chemical wastes.

On-site recycling/reuse resulted in the largest amount of waste minimization.

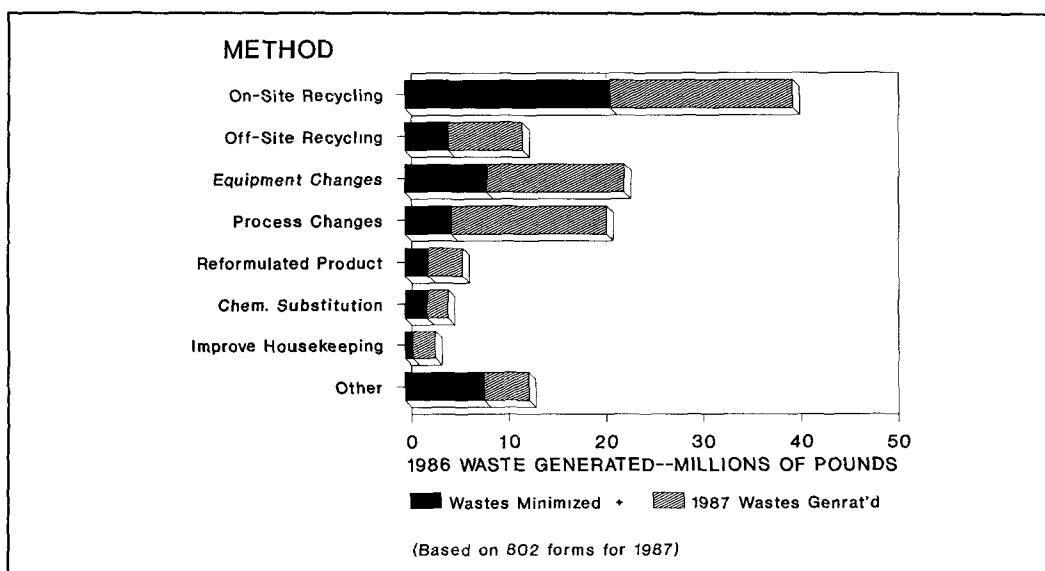


Figure 1-13.
Amount of TRI Waste Minimization by Method, 1987.

³ A subset was necessary for two reasons: (1) because the section was optional, the amount of information provided about waste minimization varied; and (2) many forms appeared to contain errors that were sorted out of the data for the sake of accuracy. Because the waste minimization data was optional, neither the full set of data nor the subset are representative of the nation as a whole.

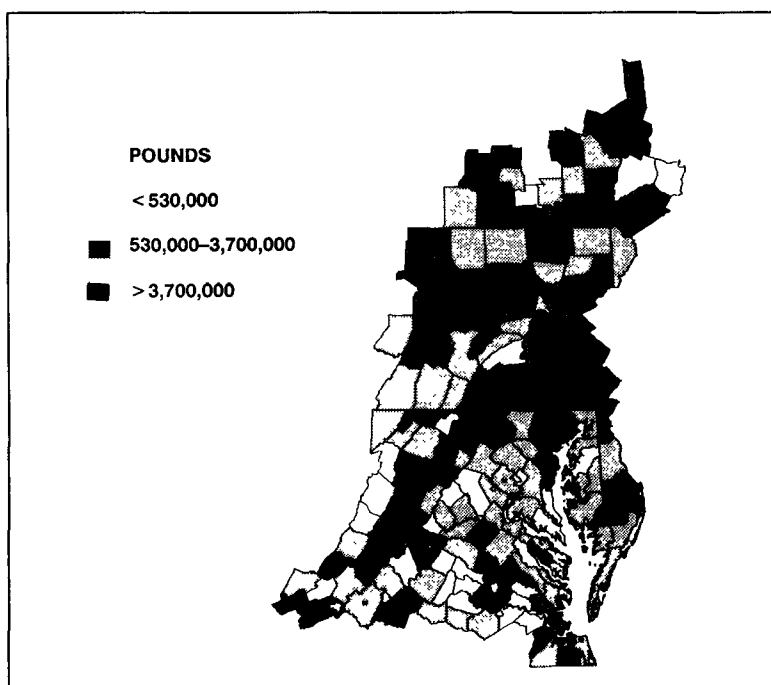
Other Analyses

This report focusses on the broad national perspectives available from 1987 Toxics Release Inventory (TRI) data. TRI data can, however, be analyzed at other levels. National analyses could be narrowed to provide greater detail about particular topics, or about regional, state, or local conditions. The two examples provided below—regional analyses of water systems and exports of chemical wastes—suggest some of the other analyses for which TRI data can be used.

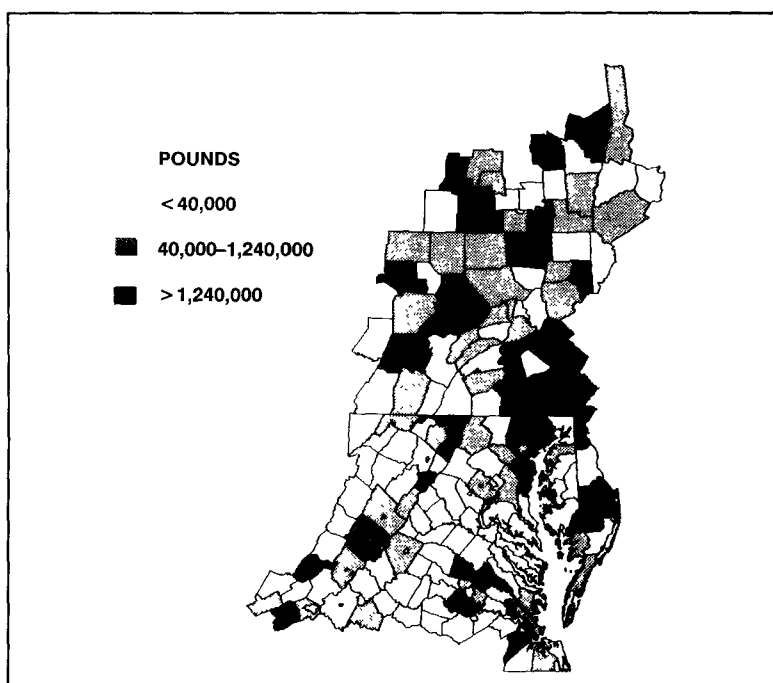
Regional Analyses: Major Water Systems

Geographical analyses could focus on releases in the drainage basins of major waterways.

Geographical analyses could focus on releases near major water systems to examine the chemicals that might eventually end up in the water. For example, six states lie in the Chesapeake Bay's drainage basin; TRI chemicals released in any of those six could potentially affect the Bay or the ecosystems it supports. TRI data can be used to locate all TRI facilities within this region by latitude and longitude and to display their releases and transfers (Map 1-3). As illustrated, the heaviest concentrations of TRI releases and transfers are in the area just north of the Bay and in another area to the southwest.



Map 1-3.
Total TRI Releases and Transfers in the Chesapeake Bay Area, 1987.



Map 1-4.
TRI Discharges to Surface Water in the Chesapeake Bay Area, 1987.

While all releases and transfers of TRI chemicals might affect the Bay region, direct discharges to surface waters may pose a more immediate concern. TRI data can be used to map all discharges of TRI chemicals to surface waters (Map 1-4) that were reported for 1987 in order to investigate the situation in more detail. Such analyses could be further refined to examine discharges of a particular chemical or set of chemicals.

TRI Chemical Exports

An analysis of TRI chemical wastes exported to other countries yields an international perspective of the manufacture and disposal of TRI chemicals. The export of TRI chemical wastes from the United States can be examined by searching the TRI data for off-site transfer locations outside the United States.

U.S. facilities exported six million pounds of toxic chemical wastes to 13 sites outside the country.

For 1987, TRI facilities identified 13 different sites outside of the country to which U.S. facilities transferred six million pounds of chemical wastes (Table 1-4).⁴ Canadian sites received the largest amounts of TRI chemical wastes. The remainder of the exported TRI chemical wastes were transferred to sites in Europe (in Belgium, Spain, and the United Kingdom). Some of the international transfers were recycled, rather than treated or released.

TABLE 1-4. TOTAL TRI RELEASES AND TRANSFERS FOR THE CHEMICAL AND ALLIED PRODUCTS INDUSTRY, 1987

SIC CODE	Y	TOTAL TRI RELEASES/ TRANSFERS	
		Pounds	Cumulative Percent
28- Chemicals & Allied Products	General	17,175,923	0.14
281 Industrial Inorganic Chemicals		1,722,789,318	14.25
282 Plastics & Synthetic Organics		533,077,745	4.41
283 Pharmaceutical & Biological Products		563,751,841	4.66
284 Soaps, Cleansers, Cosmetics		20,246,433	0.17
285 Paints		70,359,051	0.58
286 Industrial Organic Chemicals		938,658,593	7.76
287 Pesticides & Agricultural Chemicals		453,220,589	3.75
289 Printing Inks, Explosives & Other		5,317,647,271	43.99
Multiple SIC codes within SIC 28		2,451,902,907	20.28
TOTAL RELEASES AND TRANSFERS		12,088,829,671	100.00

⁴ Transfer locations were not identified for 101 million pounds (four percent) of all off-site transfers, so it cannot be determined what fraction, if any, of this amount was transported to locations outside the U.S.

GETTING ACCESS TO TRI

The TRI Reporting Center is the national repository for all TRI reports submitted to EPA. The Center can accommodate limited requests for information on individual facilities. TRI reports filed for 1987 are available from the Center, from States, and from the NLM database described below. Reports for 1988 will be available shortly after their July 1, 1989 due date. For specific requests, write the name and address of the facility of interest and send it to:

**EPA TRI Reporting Center
470-490 L'Enfant Plaza
Suite 7103
Washington, DC 20022**

Individual States can also provide TRI data.

TRI data is accessible on computer through the National Library of Medicine's TOXNET database. For information, contact:

**TRI Representative
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