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Assessment of Changes in Reported TRI Releases and Transfers Between 1989 and 1990

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CHAPTER 1
INTRODUCTION

The U.S. Environmental Protection Agency (EPA) collects data for the Toxics Release Inventory (TRI) annually pursuant to Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). TRI includes data on the types and quantities of toxic chemicals released to all environmental media by manufacturing facilities within the United States. TRI data submissions have been completed for 1987, 1988, 1989, and 1990. These data provide EPA an opportunity to examine the behavior of firms over time as they modify their practices to reduce releases of TRI chemicals.[1]

Over the past four years the quantity reported in TRI submissions has decreased annually. At the same time, the number of facilities reporting releases has increased annually. These trends suggest that facilities are successfully reducing the physical quantity of toxic chemicals entering the environment. However, prior to 1991, TRI did not include sufficient information on the reasons for changes in releases and transfers for EPA to make such a conclusion.

Many factors contribute to changes in TRI submissions, and they can be categorized as "real" changes and "paper" changes. Changes in production levels or product lines as well as materials substitution, procedure modifications, improved management, and other source reduction activities are considered real changes in chemical releases. Changes in measurement or estimation methods and changes in reporting requirements, or a firm's understanding of reporting requirements, are referred to as paper changes because they affect TRI submissions without physically reducing the quantity of chemicals released. Figure 1-1 illustrates examples of the types of real and paper changes affecting TRI submissions.

Research Triangle Institute (RTI), under a Cooperative Research Agreement with the EPA, conducted this study to assess the comparative impact of real versus paper changes on TRI submissions. In particular, the study focuses on the extent to which three factors—changes in measurement techniques, production fluctuations, and source reduction activities—affect changes in reported TRI releases.

In addition, the results of this study will be used to develop a methodology for assessing changes over time using the source reduction and recycling data that will become available with

[1] For the purposes of this report, the terms "submissions" and "releases" are both intended to mean the quantity of releases *and* transfers reported in TRI.

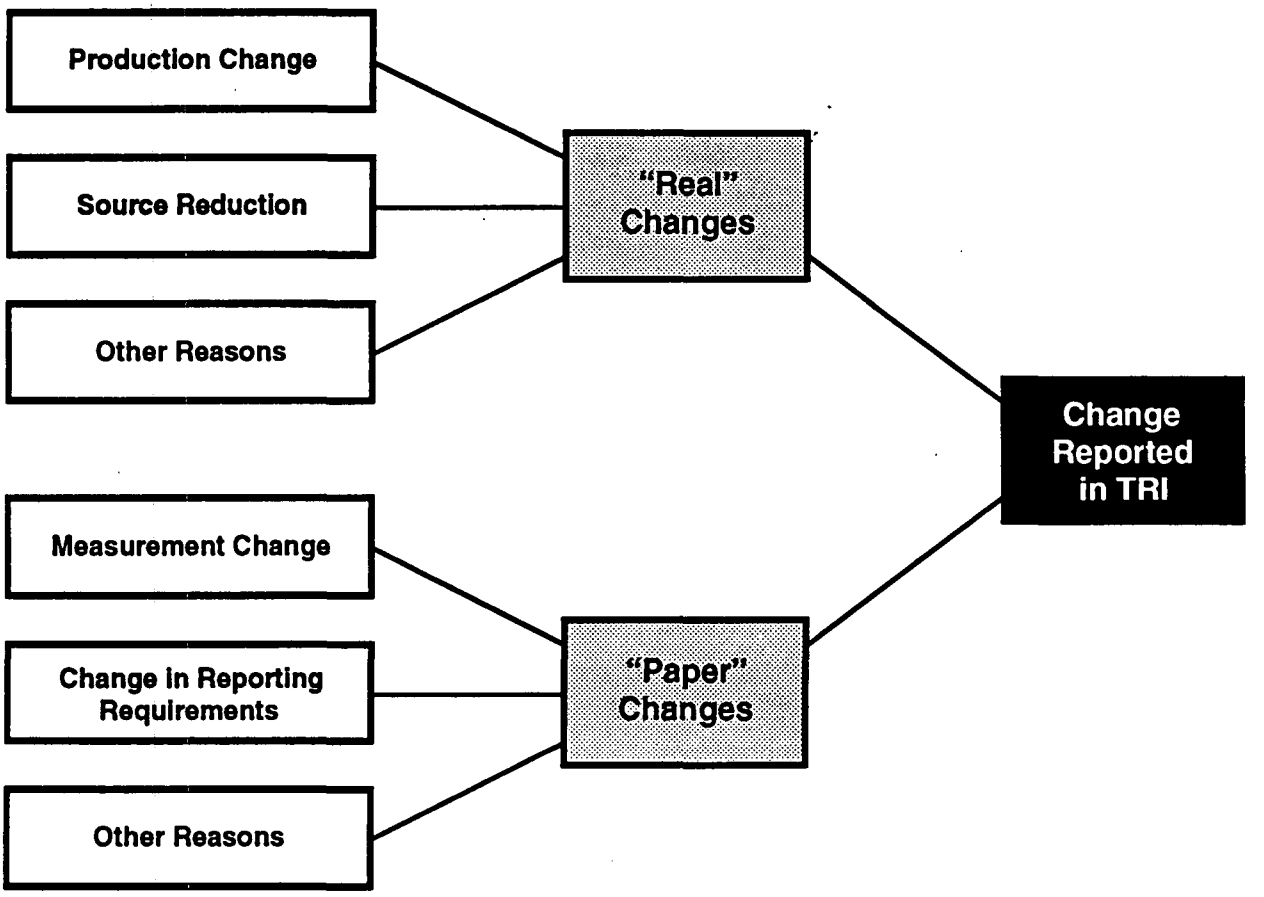

Figure 1-1. Factors Causing Changes in TRI Data Submissions

the 1991 reporting year. This methodology will help EPA evaluate changes in TRI submissions annually. Study over time is critical to developing a comprehensive understanding of the effects of source reduction activities. Many factors can cause releases to vary within and between years, and the effects of many source reduction projects may not be evident for several years or may have a cumulative effect that requires time to affect total releases.

1.1 OBJECTIVES

This study had the following objectives:

- to understand the factors affecting the change in the quantity of chemicals released and transferred, as reported in TRI;
- to determine the relative effect of each of the following on the overall change: measurement techniques, production level, and source reduction;

- to estimate the real change in the quantity of toxic chemicals released and transferred by selected industries and nationwide; and
- to estimate the quantity of pollution prevention progress achieved by selected industries and nationwide.

1.2 STUDY OVERVIEW

This study was conducted in two phases:

- Phase I: pilot study
- Phase II: main study

The Phase I pilot study examined reasons for changes in TRI releases between 1987 and 1988. For this study, the 50 facilities with the largest increases and the 50 facilities with the largest decreases in toxic chemicals released between 1987 and 1988 were contacted by telephone. Participating facilities were asked to explain differences in their 1987 and 1988 TRI data as a means of better understanding the factors that affect the data. No statistical sample was employed for the Phase I study; therefore, the results cannot be used to make national estimates of changes in releases. Nonetheless, the results indicate the factors affecting TRI data. Also, the results provided information used to develop the procedures for Phase II of this study.

Phase II was a full study of reasons for changes in TRI data between 1989 and 1990. Statistical sampling techniques were used to select facilities to be studied. The facilities selected were asked to explain their changes in measurement techniques, production level, or source reduction activities that contributed to a change in the quantity of TRI chemicals released or transferred. The results of this review were used to estimate the change in the quantity of TRI chemicals released or transferred at both industry and national levels.

1.3 REPORT OVERVIEW

This report provides estimates of the reasons for changes in TRI submissions and the methods used to develop these estimates. Chapter 2 describes the results of the Phase I pilot study and discusses the implications of Phase I on the design of Phase II. Chapter 3 discusses the procedures used in Phase II, and Chapter 4 presents the results of Phase II. Highlights of these results along with recommendations for future studies conclude the report in Chapter 5.

CHAPTER 2
PILOT STUDY METHODOLOGY AND RESULTS: REASONS FOR CHANGES IN TRI SUBMISSIONS, 1987 – 1988

A pilot study was conducted to determine the factors causing changes in reported data between 1987 and 1988. Facilities with the greatest changes (both increases and decreases) in TRI releases and transfers were contacted to determine the reasons for these changes, including the portion of change that was attributed to source reduction activities. This chapter describes the methodology and results of the pilot study.

2.1 PILOT STUDY METHODOLOGY

A subset of facilities submitting TRI data in 1988 were identified for analysis based on the magnitude of each facility's change in the total quantity of toxic chemicals released and transferred between 1987 and 1988. Specifically, the study included the 50 facilities with the largest total increases in the quantity released and transferred and the 50 facilities with the largest total decreases in the quantity released and transferred. Facility representatives were contacted by telephone and asked to identify the changes in their operating or reporting procedures responsible for the changes in data submitted for TRI.

2.2 PILOT STUDY RESULTS

Over 80 percent of the facilities contacted volunteered to participate. Specifically, out of the 50 facilities contacted in each category, respondents included 45 facilities reporting decreases and 36 facilities reporting increases. Although these facilities represent only 0.5 percent of facilities that submitted Form Rs in 1988, the total change in the quantity of releases for the facilities studied accounts for 44 percent of the total change in the quantity reported for TRI.

The explanations for changes have been divided into three categories:

- *No Real Change:* indicates that the change was a reporting change and that the real quantity of chemicals released did not change. Examples of changes under this category include changes in measurement or estimation techniques, changes in the interpretation of reporting requirements, data entry errors, and calculation errors.

- *Source Reduction:* indicates that the quantity of chemicals released actually did change and that the change can be attributed entirely to source reduction activities or the change can be attributed in large part to source reduction and the portion due to other reasons could not be estimated and distributed accordingly.

- *Other Real Change:* indicates that the quantity of chemicals released actually did change and that the change was not attributed, in whole or in large part, to source reduction activities. Examples of changes under this category include product changes, production fluctuations, and recycling.

If a facility claimed its change falls under more than one category yet emphasized one of the categories, its response was placed in that category. Thus, a portion of the quantity change listed under each category may actually be due to a combination of reasons.

Under each of the three categories, responses have been tabulated by the specific explanations for change. Tables 2-1 and 2-2 show these results separately for the increase and decrease facilities. For each explanation, the tables show the number of facilities providing that explanation, the total change due to that reason, the average change per facility, and the percentage of the total quantity of increase or decrease for the facilities studied that was attributed to that reason. Table 2-3 presents a summary of results.

2.3 PILOT STUDY CONCLUSIONS

One objective of this pilot study was to draw conclusions about source reduction progress. The results show that roughly 20 percent of the net change accounted for in the pilot study was attributed to source reduction activities. However, only 7 percent of the total quantity decrease was attributed to source reduction. These figures include changes attributed to reasons other than source reduction for which we were unable to determine the portion of the change due to source reduction alone.

The most common reasons given for changes in data reported for TRI were changes in reporting or measuring procedures. Such changes do not represent actual changes in the quantity of toxic chemicals released into the environment. Over 60 percent of the decreases studied and 54 percent of the increases studied were attributed to some type of "paper" change.

One measure commonly used to assess source reduction progress is the "adjusted measure," which adjusts changes in the quantity released for changes in production activity. This methodology assumes that the quantity released is directly related to the quantity of production activity. Facilities responding to this study attributed 6 percent of the decrease and 25 percent of the increase to changes in production activity.

This study demonstrates that a wide variety of factors affect the quantity of releases reported in TRI and that a small portion of the reported change in data can be attributed to source reduction progress.

Table 2-1. Pilot Study: Reasons for Decreases Reported in TRI

Reason for Change	Number of Facilities	Total Decrease (10^6 lbs)	Average Decrease (10^6 lbs)	Percentage of Total Decrease[a]
No Real Change				
Data entry error	6	-127.1	-21.2	24.7%
Change in interpretation of reporting requirements	7	-75.6	-10.8	14.7%
Improved estimate	8	-53.6	-6.7	10.4%
Estimate error/variation	1	-37.0	-37.0	7.2%
Calculation error	3	-14.9	-5.0	2.9%
Combined reasons, no real change	1	-2.8	-2.8	0.5%
Subtotal	b	-311.0	b	60.6%
Source Reduction				
Combined reasons, pollution prevention	5	-21.3	-4.3	4.1%
Pollution prevention	2	-16.9	-8.5	3.3%
Subtotal	b	-38.2	b	7.4%
Other Real Change				
Recycling	7	-62.3	-8.9	12.1%
Change in production level	4	-32.4	-8.1	6.3%
Combined reasons, other real change	4	-27.4	-6.9	5.3%
Weather change	1	-20.8	-20.8	4.1%
One-time event	3	-17.6	-5.9	3.4%
Change in treatment	2	-3.9	-2.0	0.8%
Subtotal	b	-164.4	b	32.0%
Total All Reasons	b	-513.6	b	100.0%

[a] Percentage of the total decrease for the facilities studied that is explained by the reason indicated.

[b] Because a single facility may have provided more than one explanation, the number of facilities cannot be summed.

Table 2-2. Pilot Study: Reasons for Increases Reported in TRI

Reason for Change	Number of Facilities	Total Increase (10^6 lbs)	Average Increase (10^6 lbs)	Percentage of Total Increase[a]
No Real Change				
Data entry error	7	65.3	9.3	20.1%
Improved estimate	5	47.7	9.5	14.7%
Change in interpretation of reporting requirements	6	35.0	5.8	10.8%
Estimate error/variation	4	26.0	6.5	8.0%
Calculation error	1	2.3	2.3	0.7%
Subtotal	b	176.3	b	54.2%
Source Reduction				
none	0	0	0	0.0%
Subtotal	0	0.0	0	0.0%
Other Real Change				
Change in production level	13	82.1	6.3	25.3%
Change in recycling	1	24.7	24.7	7.6%
Change in operating conditions	2	18.5	9.3	5.7%
Change in product/product mix	2	12.9	6.5	4.0%
Combined reasons, other real change	1	7.7	7.7	2.4%
Change in treatment	1	2.9	2.9	0.9%
Subtotal	b	148.8	b	45.8%
Total All Reasons	b	325.1	b	100.0%

[a] Percentage of the total decrease for the facilities studied that is explained by the reason indicated.

[b] Because a single facility may have provided more than one explanation, the number of facilities cannot be summed.

Table 2-3. Pilot Study: Summary of Results

	Total Change (10^6 lbs)	Percentage of Total Change (%)
Decreases		
No real change	-311.0	60.6
Source reduction and combined source reduction	-38.2	7.4
Other real change	-164.4	32.0
Total for those facilities contacted	-513.6	100.0
Increases		
No real change	176.3	54.2
Source reduction and combined source reduction	0.0	0.0
Other real change	148.8	45.8
Total for those facilities contacted	325.1	100.0
Net Change		
No real change	-134.7	71.5
Source reduction and combined source reduction	-38.2	20.2
Other real change	-15.6	8.3
Total for those facilities contacted	-188.5	100.0

Note: These figures represent the sum of responses from 45 facilities reporting decreases and 36 facilities reporting increases in TRI releases and transfers. These facilities were not statistically sampled and may not be representative of the TRI universe.

2.4 IMPLICATIONS FOR MAIN STUDY

The following observations from the pilot study have implications for Phase II of this study:

- Almost all the facilities contacted knew the reason for the change in their releases and transfers reportable under TRI.
- Within a facility, reasons for a change were generally specific to each chemical released rather than to the facility in general. For example, if a facility released zinc compounds and toluene, one reason accounted for the change in zinc compounds and a second, different reason for the change in toluene released or transferred.

- If only one reason accounted for the change in the release of a given chemical from a given facility, the quantity change could be calculated by facility. However, many facilities gave more than one reason for a change in a given chemical, making it difficult to quantify the effects of a given chemical change by reason given.

- Many of the facilities contacted had to research our questions, which required several telephone calls over several days or weeks.

The pilot study observations suggested incorporating the following procedures in the Phase II study design:

- Mail a letter explaining the study to facilities prior to contacting them by phone so they can prepare for the phone call. This letter would reduce the number of calls made per facility and provide the TRI data submissions to the facilities for easy reference during the phone call. The letter would indicate when a telephone interviewer will contact the facility.

- Structure questions so that facilities are asked about each chemical they released or transferred. During the telephone call, facilities would have to provide release and transfer information for each chemical for each year of the study.

- Require categories of combined reasons if facilities are unable to distinguish the quantity of change due to a single reason when more than one reason accounted for the change.

CHAPTER 3
MAIN STUDY METHODOLOGY

The objective of Phase II was to explain changes in reported TRI data submissions from 1989 to 1990. Statistical sampling techniques were employed to select a representative group of facilities from which population estimates could be made. The selected facilities were notified of the study by letter and then contacted by telephone to obtain their responses. Participation was entirely voluntary. This chapter describes the methods used for Phase II, including the facility selection, data collection, and sample weighting procedures. The results of Phase II are presented in Chapter 4.

3.1 SAMPLE PLAN

The sample plan was designed to estimate the change in the quantity of TRI chemicals released or transferred for each of the following populations:

- all facilities reporting TRI data in both 1989 and 1990,
- eight selected industries (based on 2-digit SIC code),
- facilities within each industry or industry group reporting decreases in TRI releases and transfers, and
- facilities within each industry or industry group reporting increases or no change in TRI releases and transfers.

3.1.1 Study Population

The study population comprises facilities with SIC codes 20 to 39 that submitted TRI data for 1989 *and* 1990. Facilities that reported in 1989 but not in 1990 due to closure and facilities that reported in 1990 as their first year in business were excluded from the study population. Facilities that submitted TRI data in 1989 and 1990 but either did not report a SIC code or reported only SIC codes not between 20 and 39 (and therefore are excluded from TRI submission requirements under the EPCRA Section 313) were also excluded from the study population.

Eight 2-digit SIC codes were studied in detail; all other SIC codes were grouped together in a ninth category. These eight industries are

- paper manufacturing (SIC 26),
- printing and publishing (SIC 27),
- chemical manufacturing (SIC 28),

- rubber and plastics manufacturing (SIC 30),
- primary metals (SIC 33),
- fabricated metals manufacturing (SIC 34),
- electrical equipment (SIC 36), and
- transportation equipment manufacturing (SIC 37).

For the purposes of this study, facilities reporting multiple SIC codes within the same 2-digit SIC category were assigned to that 2-digit SIC category. Facilities reporting multiple SIC codes in different 2-digit SIC categories were placed in the "Other" category. This method is consistent with that used by EPA's Office of Pollution Prevention and Toxics in conducting analyses using TRI data.

The study population did not include the chemical terephthalic acid (CAS number 100-21-0). Terephthalic acid was the only chemical to be delisted between the 1989 and 1990 reporting years; thus, the impact of delisted chemicals is not a factor in this study. The impact of newly listed chemicals is also not a factor since there were no new listings made between 1989 and 1990.

The resulting study population contains 18,951 facilities reporting a net decrease in TRI submissions of 866 million pounds between 1989 and 1990. This quantity change represents 92 percent of the change reported by the universe of TRI facilities at the time of selection. Table 3-1 provides a summary of the study population and its representation of the TRI universe.

Table 3-1. Study Population and Representation of TRI Universe

	TRI Universe[a]	Study Population
Number of Facilities, 1990	26,527	18,951
Number of Form Rs, 1989/1990[b]	100,875	85,780
Total Releases and Transfers, 1990	4,888,678,773	4,751,204,393
Change in Releases and Transfers (1990 – 1989)	-942,529,020	-865,979,506

[a]These figures may differ from others published by EPA because of the time and criteria of selection.
[b]This includes Form Rs that were submitted for either 1989 or 1990. If a facility added or dropped a chemical between the two years, its Form R would still be included.

3.1.2 Sample Allocation

The study sample was designed to have equal allocation across the selected industry groups, allowing us to provide estimates of equal precision for each group. Hence, appropriate comparisons between industry groups can be made.

The industry groups were stratified by increases/no change and decreases in TRI releases and transfers. Within industry groups an equal allocation sample was used for selecting facilities with increases/no change and decreases in TRI submissions. In addition, the sample included a census of the five facilities with the greatest increases and the five facilities with the greatest decreases in TRI releases for each of the nine industry strata.

The desired sample size for Phase II was 972 facilities. The actual sample size, however, was increased to 1,206 facilities to account for an estimated 20 percent nonresponse rate. Nonresponses included facilities that chose not to participate in the study and those that were no longer in business or could not be reached during the interview period. The sampled facilities were allocated to 36 cells in the 9-by-4 matrix design shown in Table 3-2.

Table 3-2. Distribution of Facilities into Strata for Study Sample of 1,206 Facilities

SIC	Largest Decreases	Decreases	Increases/ No Change	Largest Increases	Total
26	5	62	62	5	134
27	5	62	62	5	134
28	5	62	62	5	134
30	5	62	62	5	134
33	5	62	62	5	134
34	5	62	62	5	134
36	5	62	62	5	134
37	5	62	62	5	134
Other[a]	5	62	62	5	134
Total	45	558	558	45	1,206

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

3.2 DATA COLLECTION PROCEDURES

Prior to being contacted by telephone, the selected facilities received information to introduce them to this study. The introductory mail-out package included the following:

- a cover letter from EPA explaining the purpose of the study,
- a summary of the questions to be covered and the procedures for conducting the telephone interviews, and
- print-outs from the EPA database of the facility's TRI data for each chemical released and transferred.

These mail-out materials helped facilities prepare for the interview and served as a convenient reference during the interview. Thus, when contacted, facilities could complete the review in a smooth and efficient manner.

Appendix A includes a copy of the cover letter EPA sent to facilities selected for Phase II of the study. The appendix also shows the TRI data facilities received for each chemical for which they submitted TRI data. The example in the appendix includes simulated TRI data for a fictitious facility. Appendix B contains the interview script, and Appendices C and D contain copies of the 1989 and 1990 Form Rs, respectively.

A computer-assisted telephone interview (CATI) process was used to collect the data for Phase II of this study. CATI interviewers contacted representatives from the 1,206 facilities selected for this study and asked if the quantity of chemicals released and transferred reported in TRI changed between 1989 and 1990 because of the following:

- changes in measurement or estimation techniques,
- changes in the level of production activity, or
- source reduction activities.

In addition, facilities attributing change to source reduction were asked to identify which of the following source reduction activities they employed:

- equipment or technology modification;
- process or procedure modification;
- reformulation or redesign of products;
- substitution of raw materials;
- improvement in housekeeping, maintenance, training, or inventory control; or
- other source reduction activity.

As mentioned in Chapter 2, the results of Phase I of this project suggest that explanations for changes in TRI submissions were generally specific to each chemical. Therefore, in Phase II *each* TRI chemical was reviewed separately. Facilities that had submitted Form Rs for more than 20 TRI chemicals were exempted from this procedure. To reduce the time needed to complete the review, these facilities were asked to explain the reasons for change for only those chemicals making up 80 percent of their total change.

3.3 APPLICATION OF WEIGHTS

Statistical weights were calculated and applied to the sample data to determine population estimates. This section describes the methods for selecting the weighting design, the weighting adjustments that were necessary once the data had been collected, and the precision of the resulting weighted estimates.

3.3.1 Weighting Design

Applying weights to sampled data allows us to make estimates for the entire population of facilities. A weight is a factor used to escalate from a sample measurement to an estimate for the total population. For example, if a single facility were sampled from a population of ten facilities, multiplying (or weighting) the responses of the sampled facility by ten gives an estimate of the total population.

The weighting design is determined by the type of analysis desired. The following types of estimates for each of the nine industry groups and four change strata of the sample design were of interest to this study:[1]

- the number of facilities attributing change to measurement change, production change, and/or source reduction;
- the number of chemical-level changes attributed to measurement change, production change, and/or source reduction; and
- the quantity change attributed to measurement change, production change, and/or source reduction.

Three sets of weights were needed to make these types of estimates: facility-level frequency weights, chemical or Form R-level frequency weights, and quantity weights. These are described below.

[1] In addition, the study sample included sufficient coverage to make weighted estimates of the reasons for change for chemical-specific quantities (e.g., 33/50 chemicals). However, this type of analysis was not possible given the resource and time constraints of this study.

Facility-Level Frequency Weights

Facility-level weights were calculated by industry and change strata so that the weighted value for each of the cells in the sample design equals the actual number of facilities in the study population. Table 3-1 shows the distribution of the 1,206 sampled facilities into the industry and change strata of the sample design. Table 3-3 shows how the 18,951 facilities of the study population are actually distributed among the design strata. Each cell in Table 3-1, when weighted, takes on the value of the corresponding cell in Table 3-3. For example, the 62 facilities sampled from SIC 26 with decreases in their TRI submissions have a weight or multiplier that escalates their value up to 302—the number of facilities from the population in the same industry/change strata. The total weighted value for sampled facilities is 18,951—the number of facilities in the study population.

Table 3-3. Distribution of Facilities into Strata for Study Population of 18,951 Facilities

SIC	Largest Decreases	Decreases	Increases/ No Change	Largest Increases	Total
26	5	302	237	5	549
27	5	156	135	5	301
28	5	1,975	1,576	5	3,561
30	5	779	637	5	1,426
33	5	801	603	5	1,414
34	5	1,406	1,070	5	2,486
36	5	878	554	5	1,442
37	5	633	381	5	1,024
Other[a]	5	3,734	3,004	5	6,748
Total	45	10,664	8,197	45	18,951

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

The largest increase/decrease strata include a census of facilities. Consequently, only a weight of one was applied. By including these facilities with a weight of one, the behavior of very large facilities can be studied without distorting the population estimates.

Form R-Level Frequency Weights

The Form R-level weights were calculated in the same manner as the facility-level weights. Sample data for each of the industry and change strata were weighted to represent the actual number of Form Rs in the population. Form Rs for the facilities of the largest increases/decreases strata were given a weight of one. The total weighted value for sampled Form Rs is 85,780—the total number of Form Rs in the study population.

Quantity Weights

Quantity weights were applied to sample data so that the 1989 to 1990 *change* in releases and transfers for sampled Form Rs would represent the real *change* in releases and transfers for the study population. Once determined, these weights could then be applied to the quantity responses for each of the three change variables (measurement, production, and source reduction) to make population estimates of the reasons for change in TRI submissions.

However, study participants were not required to account for the full quantity change for each of their Form Rs. Rather, participants were asked to estimate, if possible, the quantity change for each Form R that could be attributed to measurement change, production change, and source reduction. If respondents attributed the quantity change to other reasons or if they were unable to estimate the quantity change, then the sum of their responses would not equal their change in TRI submissions. Consequently, a fourth change variable "Other Factors" was necessary to complete the following equation:

Measurement Change	+	Production Change	+	Source Reduction	+	Other Factors	=	1990 TRI Submission	−	1989 TRI Submission

Thus, the weighted value of the four change variables equals the change in TRI submissions for the population—a decrease of 866 million pounds.

3.3.2 Adjustment to Weights

Once the data had been collected and the interview procedure was complete, the three weights initially applied to the sample for nonresponse were adjusted (facilities that could not be reached to complete the interview or facilities that chose not to participate). Eighty percent of the sampled facilities volunteered to participate in the study. Weights for facilities that did not participate were reduced to zero, and weights for participants were adjusted so that their weighted value would represent the entire population of facilities.

3.3.3 Precision of Weighted Estimates

Confidence intervals are used to measure the accuracy of weighted estimates. The confidence interval is the range of numbers within which the true value of an estimated number will fall with a certain known probability based on the statistical design of the survey and the response rate obtained. A 95 percent confidence interval means that if a survey were conducted 100 times, the estimates would fall within the confidence interval 95 percent of the time.

The target precision for this study was to produce estimates for a given industry and change strata with a 95 percent confidence interval of plus or minus 14 percent. This target would require an 80 percent response rate or 50 participants per industry/change category sampled. The largest increases/decreases strata, being a census and not a sample, are not subject to these precision criteria. However, an 80 percent response rate, or four participants per industry/change category censused, was desired.

Though participation in this study was entirely voluntary, the target response rate of 80 percent was easily achieved. The response rate by strata, however, varies. Table 3-4 shows the percentage of participants for each of the cells in the sample design. A total of 960 facilities volunteered to participate in this study.

Of the 20 percent of the sample that did not participate, 12 percent were still pending (i.e., TRI contacts were on vacation or otherwise unavailable at the time of the calls), 7 percent chose not to participate, and the remaining 1 percent had gone out of business. With an 80 percent response rate and only a 7 percent refusal rate, response bias should have minimal, if any, effect on study results.

Confidence intervals have not been calculated for the estimates provided in the remainder of this report. The purpose of the preceding discussion is to demonstrate that, on average, estimates for each of the industry and change categories have a confidence interval of 95 percent plus or minus 14 percent. Actual confidence intervals would vary by strata depending on the response rate.

Table 3-4. Response Rate: Percentage of Facilities Sampled that Volunteered to Participate

SIC	Largest Decreases	Decreases	Increases/ No Change	Largest Increases	Total
26	80.0	87.1	90.3	60.0	87.3
27	60.0	79.0	67.7	100.0	73.9
28	100.0	80.6	88.7	100.0	85.8
30	60.0	74.2	87.1	100.0	80.6
33	100.0	64.5	82.3	80.0	74.6
34	80.0	87.1	83.9	80.0	85.1
36	100.0	66.1	77.4	60.0	72.4
37	80.0	82.3	88.7	40.0	83.6
Other[a]	40.0	74.2	79.0	20.0	73.1
Total	77.8	77.2	82.8	71.1	79.6

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

CHAPTER 4
MAIN STUDY RESULTS: REASONS FOR CHANGES IN TRI SUBMISSIONS, 1989 – 1990

In Phase II of the study, data collected from TRI facilities were used to explain the reasons for changes in TRI releases and transfers between 1989 and 1990. Of the 1,206 facilities that were randomly selected, a total of 960 facilities, or 80 percent of the sample, volunteered to participate. Weighting these responses gave population estimates at both the industry and national levels. This chapter presents the results of this analysis.

4.1 SUMMARY DATA: NATIONAL ESTIMATES

The 18,951 facilities of the study population decreased their reported TRI submissions between 1989 and 1990 by 866 million pounds. This section provides national estimates of the extent to which this decrease can be attributed to each of the following reasons:

- changes in measurement or estimation techniques,
- changes in the level of production activity, and
- source reduction activities.

4.1.1 Frequency Estimates: Number of Facilities and Form Rs Indicating Each Reason for Change

The weighting design used for this study allowed us to make two types of frequency estimates: facility-level estimates and Form R-level estimates. Facility-level estimates are important in evaluating the behavior of the firm (e.g., the number of facilities that have implemented pollution prevention programs, or the number facilities that have altered production activities due to economic or other conditions). Form R or chemical-level estimates are important in evaluating changes/progress across the TRI universe of chemicals.

Table 4-1 presents the frequency results of Phase II of this study. Any individual facility or Form R can be tabulated under each column. Thus, if all facilities indicated a particular reason for a change (e.g., measurement change) the total for that reason category would be 18,951—the total number of facilities in the study population. Likewise, if facilities indicated a particular reason (e.g., production change) for all their Form Rs, the total for that reason category would be 85,780—the total number of Form Rs in the study population.

The impact of production fluctuations was the most common reason for change—69 percent of all facilities claimed an impact. Nearly 40 percent of all facilities realized a change in TRI releases and transfers due to source reduction activities. The actual percentage of

Table 4-1. Number and Percentage of Facilities and Form Rs Indicating Each Reason for Change

	Reasons		
	Measurement Change	Production Change	Source Reduction
Number of Facilities	4,630	13,124	7,570
Percentage of Facilities	24.4%	69.3%	39.9%
Number of Form Rs[a]	12,545	38,525	15,767
Percentage of Form Rs[a]	14.6%	44.9%	18.4%

[a]These estimates may be low. Facilities that submitted more than 20 Form Rs were asked to explain the reasons for change for only those chemicals making up the top 80 percent of their total change. Consequently, 4 percent of the Form R population was excluded from the interview process.

facilities that have implemented source reduction programs, however, may be even higher because the results of prevention programs may not be evident for several years after implementation. A change in measurement or estimation techniques, a form of "paper" change, was the least common reason for change.

As expected, the trend in Form R responses follows that of the facility-level responses: production change was the most common and measurement change was the least common reason for change. In each case, however, the percentage response is considerably lower for Form Rs than for facilities. This difference indicates that each change variable, though having some effect on a facility's submissions, did not affect all the chemicals released or transferred by the facility. For example, a new measurement technique may have been employed for one but not all of a facility's reported chemicals.

4.1.2 Quantity Estimates: Quantity Change Attributed to Each Reason for Change

The quantity estimates resulting from this study are evaluated in two ways. The first and traditional approach to examining yearly changes in TRI submissions is to evaluate net change. This approach, however, may mask the dynamics behind the quantity change figures because large quantity increases and large quantity decreases may cancel each other out. The second and more illuminating approach is to examine individually the increase and decrease quantities that make up the net change.

Figure 4-1 shows how the 866 million pound net decrease in TRI submissions between 1989 and 1990 is apportioned between measurement changes, production changes, source reduction, and other factors. Other factors include changes due to reasons other than the three change variables of this study (e.g., changes due to recycling, data errors, and technical guidance). Section 4.3.4 discusses and quantifies the other factors influencing TRI submissions.

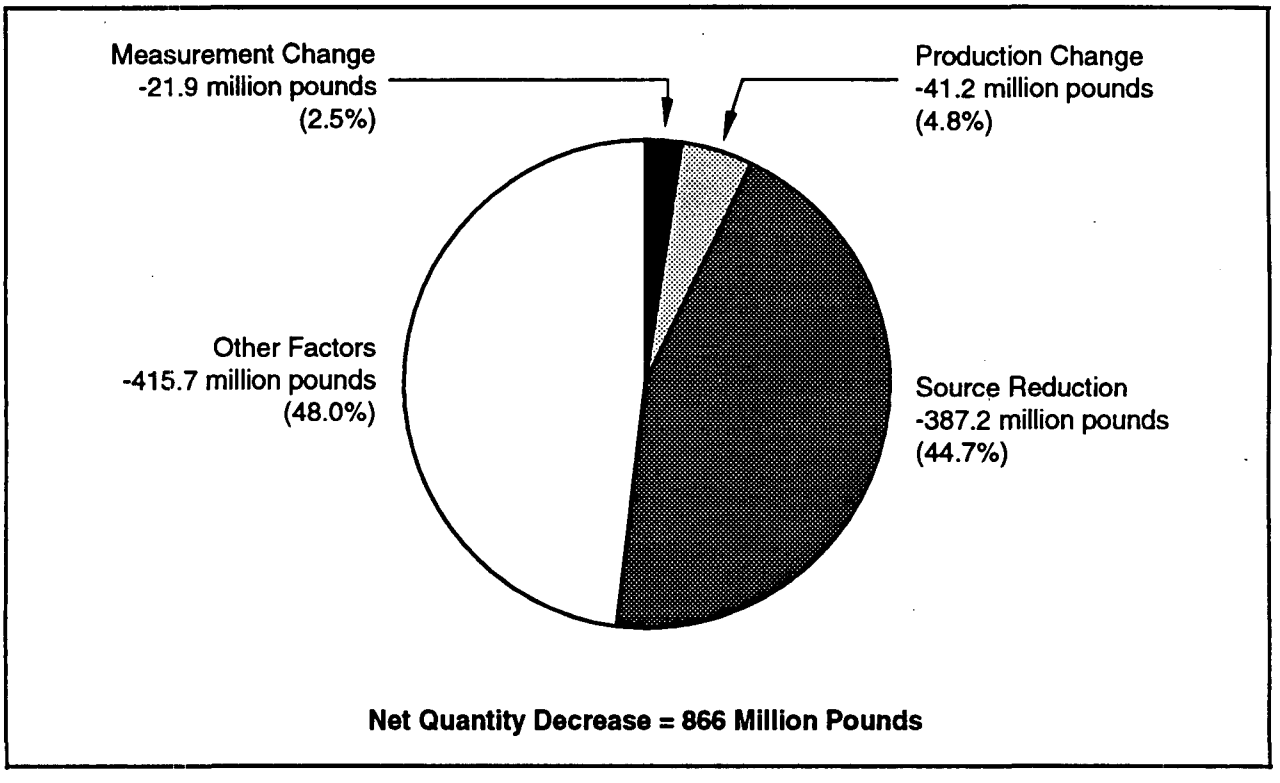

Figure 4-1. Net Quantity Change in TRI Submissions, by Reason

Nearly 45 percent of the net decrease in TRI submissions was due to source reduction activities. An estimated 5 percent of the change was due to production change, less than 3 percent was due to measurement change, and the remaining 48 percent was due to other factors. Thus, at least 50 percent of the net change (production change and source reduction combined) falls under the category of "real" change. Only 3 percent of the net change can be labeled with certainty as "paper" change; however, the remaining 48 percent decrease combines both real and paper changes.

Figure 4-2 shows the net quantity change in releases and transfers as a percentage of 1989 total releases and transfers where the removed piece of the pie represents the 866 million pound decrease or 15 percent of 1989 releases and transfers. Source reduction accounted for 7 percent of the decrease in 1989 releases and transfers, production and measurement change together accounted for 1 percent, and other factors contributed to the remaining 7 percent.

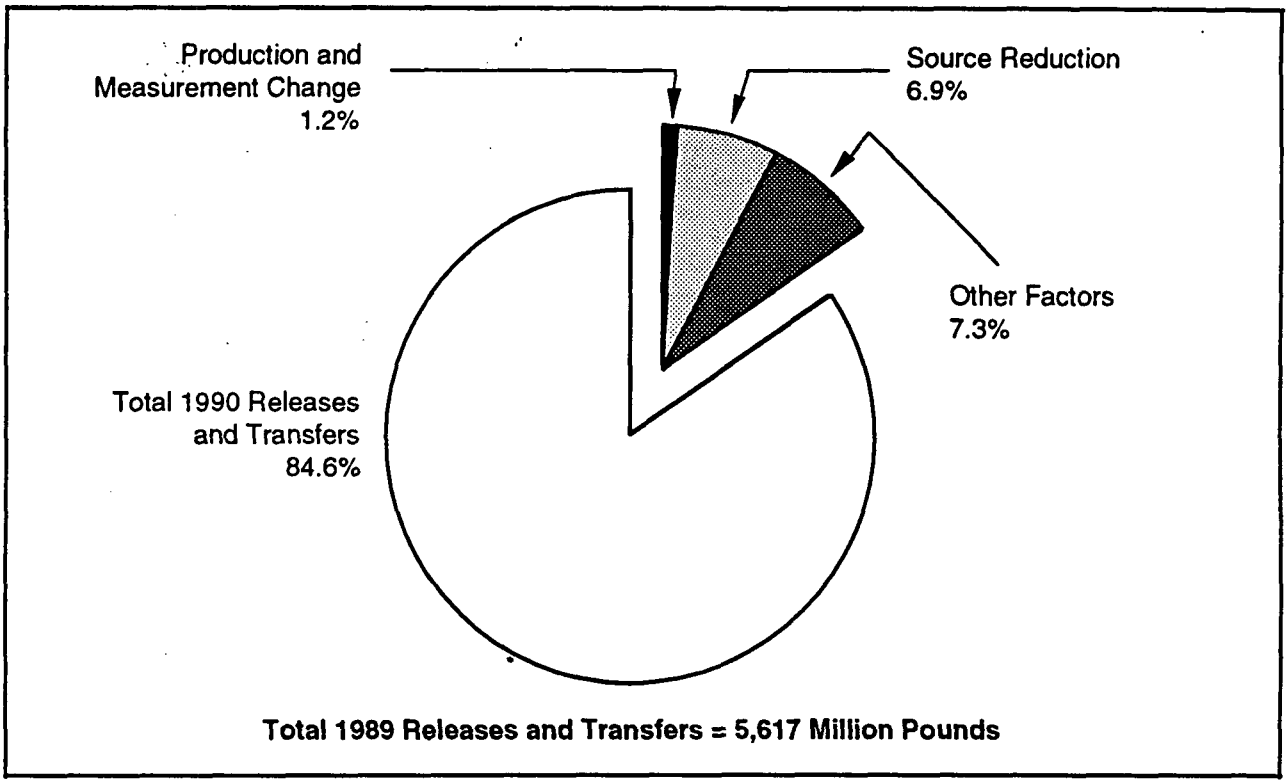

Figure 4-2. Net Quantity Change as a Percent of 1989 Releases and Transfers

Both Figures 4-1 and 4-2 represent net changes—the traditional way of presenting changes in TRI submissions. Figure 4-3 shows how the net change figures are derived from quantity increases and decreases and illustrates the importance of evaluating change by its components.

Although the net change for all three variables is a decrease, both increases and decreases were attributed to each variable. The greatest absolute quantity change was attributed to production change, indicating that although the aggregated impact of production change is comparatively small, large quantity increases and decreases are associated with production changes.

4.2 SUMMARY DATA: INDUSTRY ESTIMATES

In addition to national estimates of the extent to which measurement change, production change, and source reduction affect TRI submissions, we provide similar estimates for the nine industry strata selected.

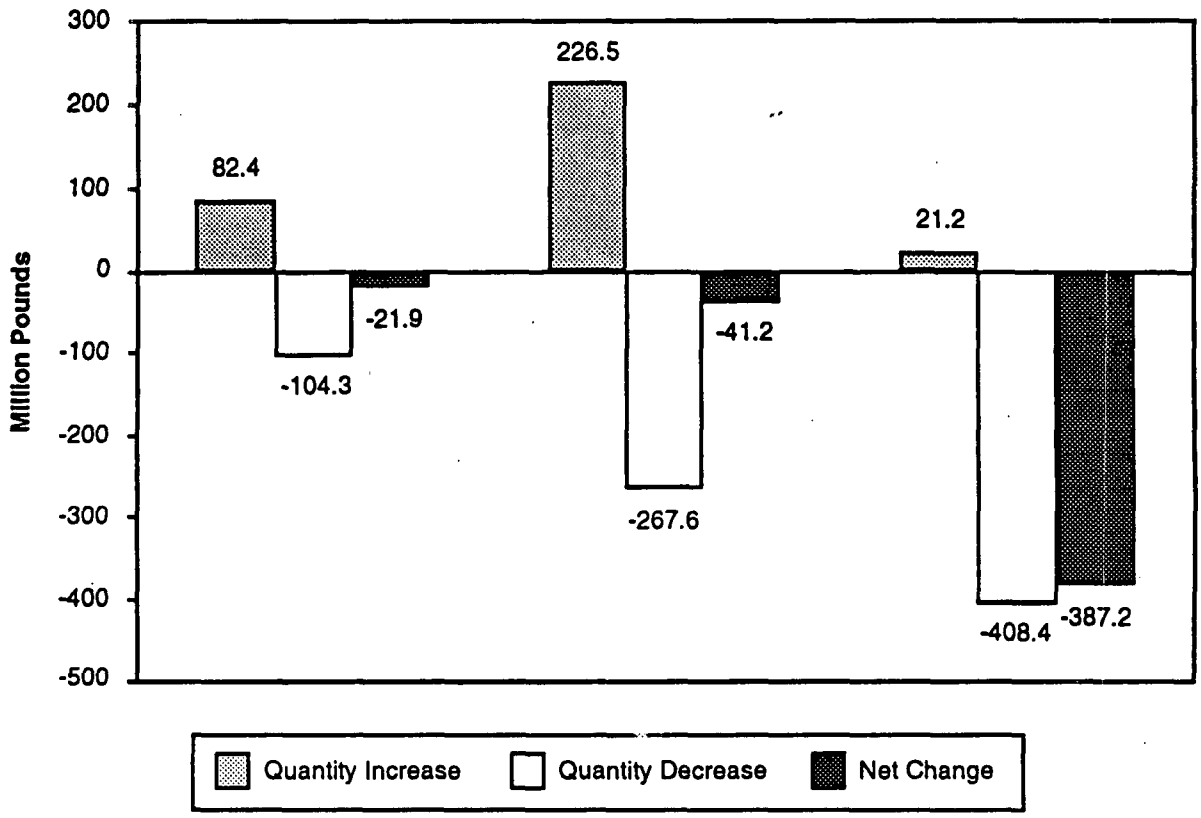

Figure 4-3. Aggregating Increases and Decreases in TRI Submissions, by Reason

4.2.1 Frequency Estimates: Number of Facilities and Form Rs Indicating Each Reason for Change, by Industry

Table 4-2 shows the percentage of facilities indicating measurement change, production change, and source reduction for each of the nine industry groups studied. Table 4-3 shows the same percentage information for chemical-level responses. These data indicate that there is little variance between industry groups in the percentage of Form Rs and facilities impacted by each of the three change variables.

4.2.2 Quantity Estimates: Quantity Change Attributed to Each Reason for Change, by Industry

Tables 4-4 through 4-6 show the net quantity change, quantity increase, and quantity decrease attributed to each of the three change variables for the nine industry groups studied.

Table 4-2. Percentage of Facilities Indicating Each Reason for Change, by Industry

SIC	Industry	Measurement Change	Production Change	Source Reduction
26	Paper	29.5	68.3	52.5
27	Printing and publishing	12.6	75.4	46.2
28	Chemical	32.6	77.2	47.8
30	Rubber and plastics	18.4	70.3	34.6
33	Primary metals	27.2	71.7	45.0
34	Fabricated metals	23.0	62.2	40.6
36	Electric Equipment	20.1	63.0	42.0
37	Transportation	30.9	71.1	50.1
	Other[a]	21.4	67.8	32.4
	Total	24.4	69.3	39.9

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Note: Percentages listed by SIC group represent the number of facilities indicating each reason divided by the total number of facilities in each SIC group. Only the total row shows the responses as a percentage of the total population.

Table 4-3. Percentage of Form Rs by Reason for Change, by Industry

SIC	Industry	Measurement Change	Production Change	Source Reduction
26	Paper	16.7	44.9	21.1
27	Printing and publishing	9.3	56.8	28.4
28	Chemical	12.9	45.1	17.5
30	Rubber and plastics	22.9	46.9	17.6
33	Primary metals	11.8	42.0	18.5
34	Fabricated metals	14.4	45.7	17.9
36	Electric Equipment	10.4	41.4	19.3
37	Transportation	14.4	44.5	29.2
	Other[a]	16.5	45.3	16.5
	Total	14.6	44.9	18.4

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Note: Percentages listed by SIC group represent the number of facilities indicating each reason divided by the total number of facilities in each SIC group. Only the total row shows the responses as a percentage of the total population.

Table 4-4. Population Estimates: Net Quantity Change Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Change
26	6.4	12.1	-16.2	-33.8	-31.5
27	-2.1	0.9	-5.3	-0.4	-6.9
28	12.8	-99.4	-180.9	-330.1	-597.6
30	2.5	7.4	-5.9	-17.5	-13.5
33	-14.9	56.6	-58.9	6.2	-11.0
34	-6.4	6.4	-11.0	-11.5	-22.5
36	1.2	0.1	-7.7	-16.7	-23.2
37	9.6	-6.5	-37.7	-0.4	-35.1
Other[a]	-31.0	-18.7	-63.5	-11.6	-124.7
Total Change	-21.9	-41.2	-387.2	-415.7	-866.0
Percentage Change	3%	5%	45%	48%	100%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Table 4-5. Population Estimates: Quantity Increase Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Increase
26	25.0	19.6	0.1	16.8	61.3
27	0.7	2.4	0.1	4.2	7.3
28	17.9	46.6	0.2	419.9	484.6
30	2.7	14.0	2.6	25.1	44.3
33	3.2	79.1	6.2	217.3	305.7
34	2.6	26.2	1.7	26.1	56.6
36	2.7	5.9	2.2	20.0	30.7
37	11.8	9.0	3.8	28.4	53.0
Other[a]	15.9	23.9	4.4	117.5	161.7
Total Increase	82.4	226.5	21.2	875.1	1,205.2
Percentage Increase	7%	19%	2%	73%	100%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Table 4-6. Population Estimates: Quantity Decrease Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Decrease
26	-18.6	-7.5	-16.3	-50.5	-92.8
27	-2.7	-1.5	-5.4	-4.6	-14.2
28	-5.1	-146.0	-181.1	-750.0	-1,082.2
30	-0.2	-6.6	-8.5	-42.5	-57.8
33	-18.1	-22.5	-65.1	-211.1	-316.7
34	-9.0	-19.9	-12.7	-37.5	-79.1
36	-1.6	-5.8	-9.9	-36.7	-53.9
37	-2.2	-15.5	-41.6	-28.8	-88.0
Other[a]	-46.8	-42.5	-67.9	-129.1	-286.4
Total Decrease	-104.3	-267.6	-408.4	-1,290.8	-2,071.2
Percentage Decrease	5%	13%	20%	62%	100%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

4.3 ANALYSIS OF RESULTS, BY REASON

Analysis of results for the three change variables that are the focus of this review are provided below. A discussion and limited quantification of other factors affecting TRI submissions are also included.

4.3.1 Measurement Change

Measurement change is the one study variable considered a "paper" change (i.e., a change affecting TRI submissions without physically altering the quantity of chemicals released). For example, a facility's chemical releases may have remained the same from 1989 to 1990, yet a change in estimation techniques from best engineering judgment to a mass balance calculation may have led to a more accurate, yet significantly different, TRI submission.

On the national level, measurement change had the smallest impact of the three factors studied. Only 15 percent of the Form Rs had some change due to new measurement or estimation techniques. This percentage accounted for an increase of 82 million pounds, a decrease of 104 million pounds, and a net decrease of 28 million pounds, which is less than 3 percent of the net change.

At the industry level, the impact of measurement change was, likewise, relatively small. However, the net change varied from industry to industry. Four of the SIC groups showed a net decrease due to measurement change, and the remaining five SIC groups showed a net increase. The printing and publishing industry had both the lowest percentage of facilities and Form Rs affected by measurement change.

Figure 4-4 shows the percentage of facilities indicating measurement change for each of the nine industry groups studied. Figure 4-5 shows the net quantity change, quantity increase, and quantity decrease attributed to measurement change.

4.3.2 Production Change

Production change had the greatest absolute quantity change. Over 494 million pounds (a 227 million pound increase and a 268 million pound decrease) were attributed to production change. This figure supports the estimate that nearly 70 percent of all facilities attributed some portion of their change to the impact of production fluctuations. Due to quantity increases and decreases canceling each other out, however, only 5 percent of the net quantity change can be attributed to production fluctuations.

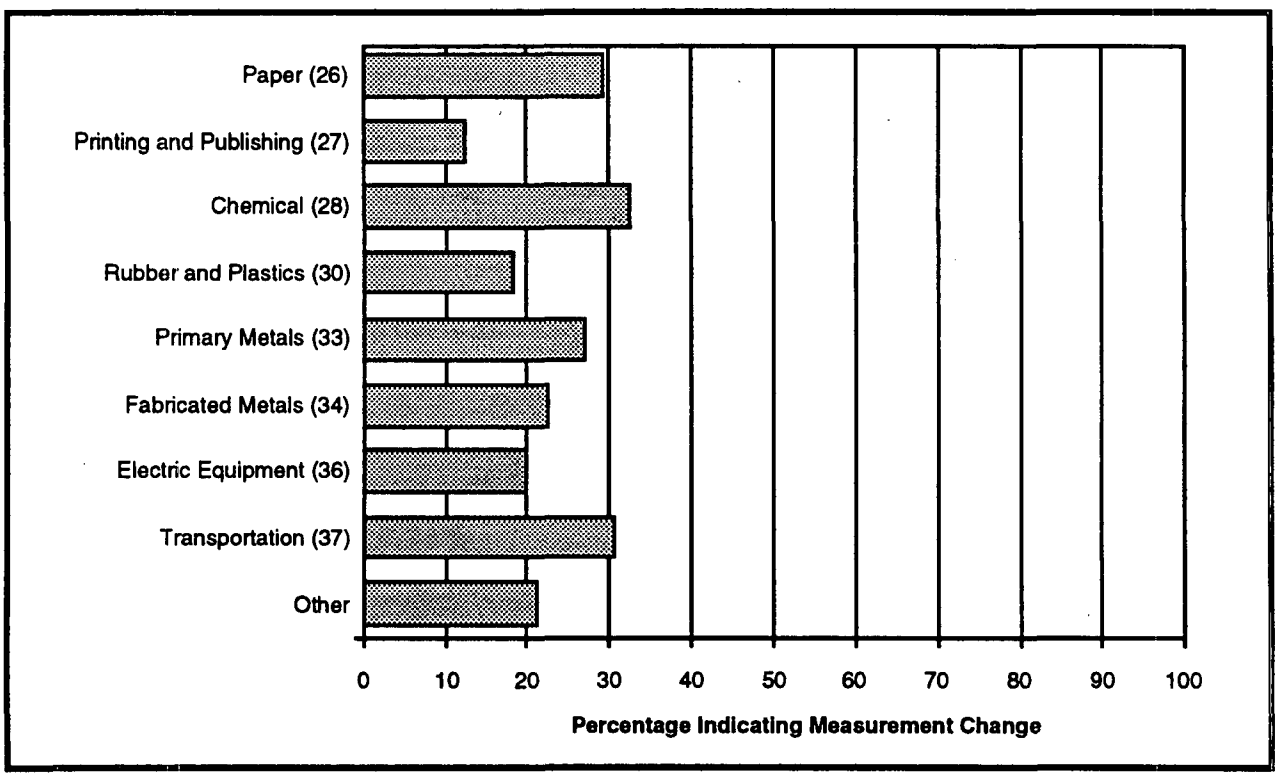

Figure 4-4. Percentage of Facilities Indicating Measurement Change, by Industry

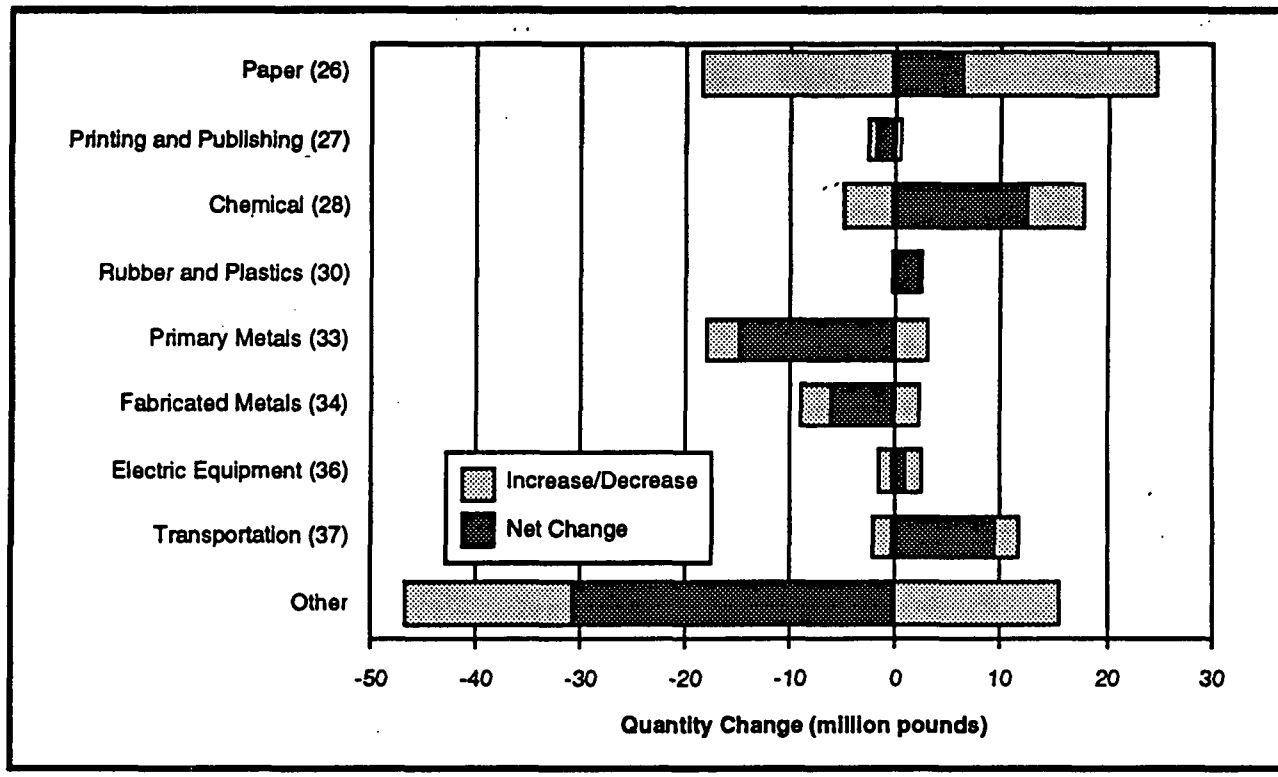

Figure 4-5. Quantity Change Attributed to Measurement Change, by Industry

Production change was also the most frequently cited reason for change for each of the nine industry groups. The chemical industry (SIC 28), more than any other industry, cited the effect of production fluctuations. As with measurement change, the net impact due to production change varied from industry to industry. Most industries showed a net increase due to production change; however, a comparatively large net decrease in the chemical industry of 98 million pounds outweighed the net increase values, resulting in a net decrease at the national level.

The impact due to production change may differ between the TRI universe and the study population. One of the criteria for selecting the study population was that facilities had to have filed Form Rs for both 1989 *and* 1990 (if a facility went out of business before 1990, it would not have been included). Thus, the production estimates resulting from our review do not include the impact of business start-ups and closures.

Figure 4-6 shows the percentage of facilities indicating production change for each of the nine industry groups studied. Figure 4-7 shows the quantity increase, decrease, and net change attributed to production change.

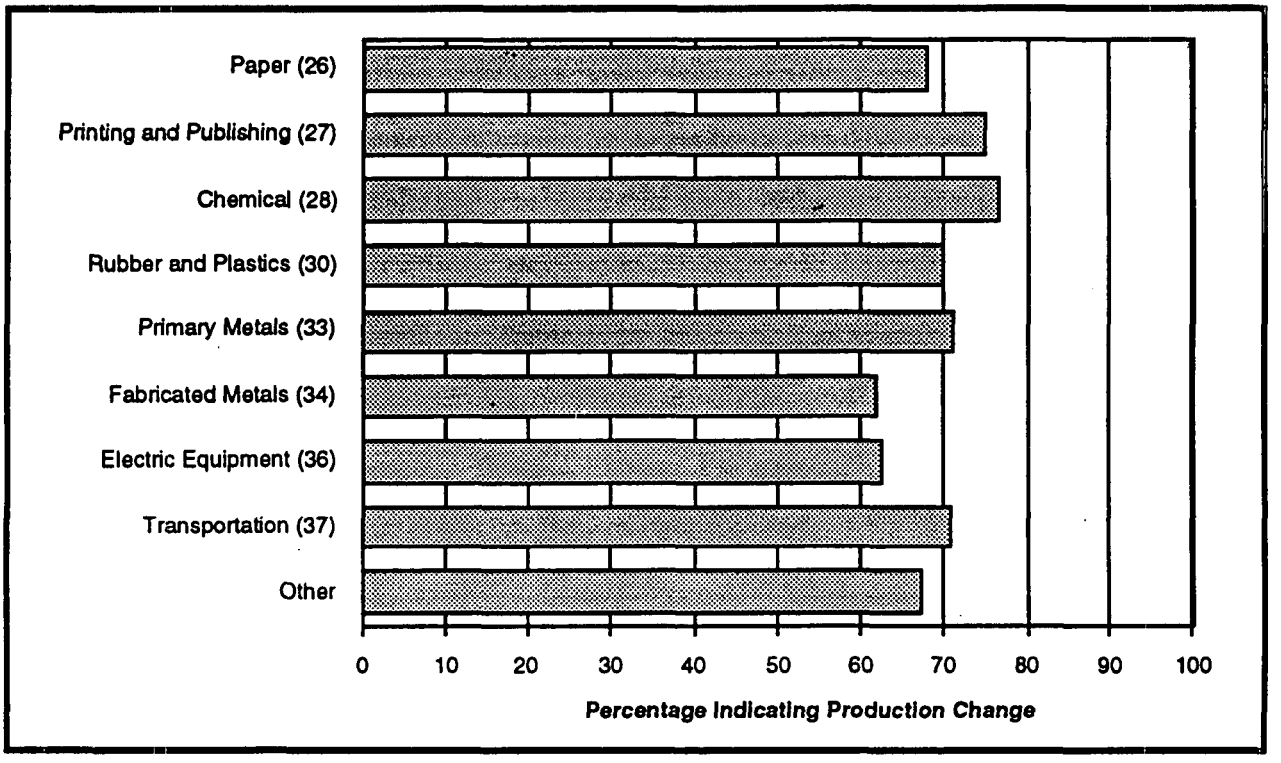

Figure 4-6. Percentage of Facilities Indicating Production Change, by Industry

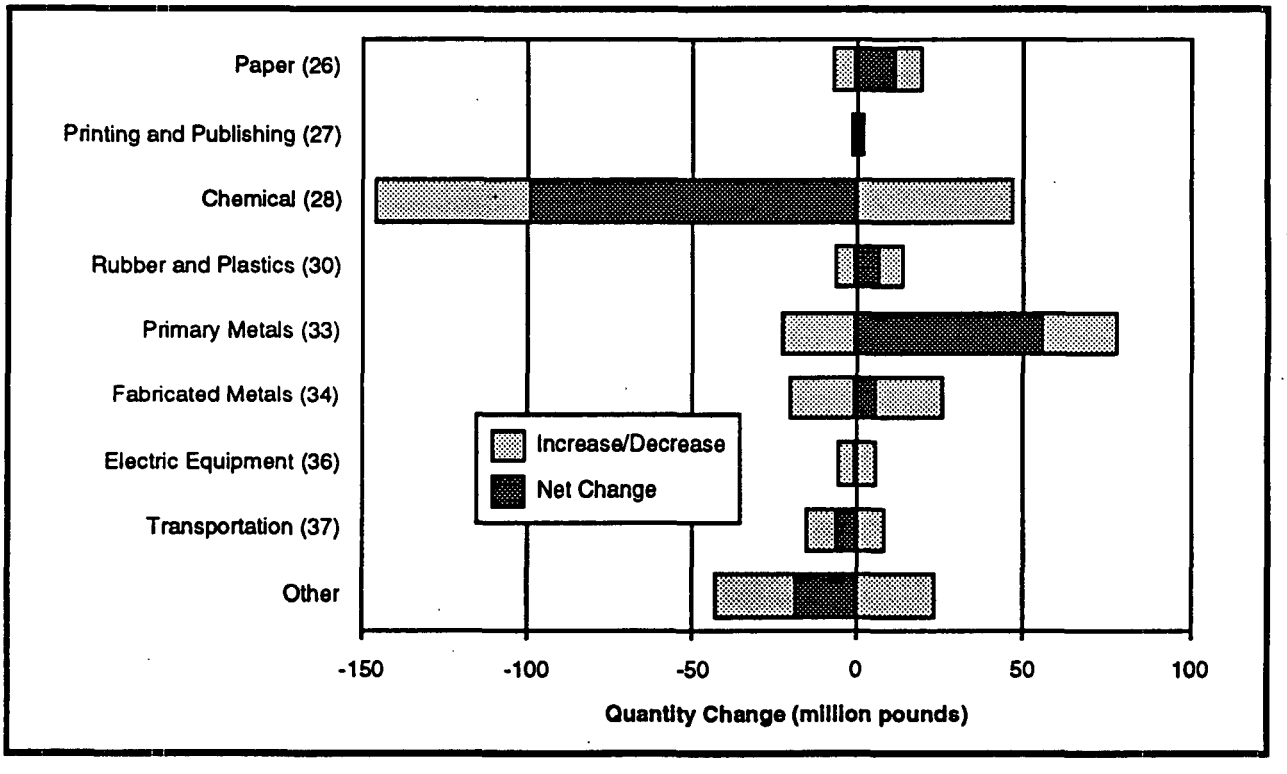

Figure 4-7. Quantity Change Attributed to Production Change, by Industry

4.3.3 Source Reduction

Approximately 40 percent of all facilities attributed some portion of their change to source reduction. This is significantly higher than the 11 percent of facilities that voluntarily reported attempts at waste minimization on the optional section of the 1989 Form R. The net change attributed to source reduction was 387 million pounds or 45 percent of the total net change. This total represents the sum of a 21 million pound increase and a 408 million pound decrease due to reduction activities.

Surprisingly, respondents indicated an *increase* due to source reduction for over 7 percent of their Form Rs affected by source reduction. The most common reason for this increase was materials substitution, whereby facilities reduced their use of certain TRI chemicals by replacing them with other (presumably less toxic) chemicals to achieve the same result. This increase in the releases and transfers of substitute chemicals is the by-product of reduction activities.

At the industry level, source reduction accounted for the greatest net decrease for all SIC groups. Of the three change variables, source reduction also accounted for the greatest quantity decrease for all SIC groups except the fabricated metals industry (SIC 34), which had a larger quantity decrease due to production change. The chemical industry (SIC 28), with a net decrease of 181 million pounds attributed to source reduction, contributed over one-half of the total net decrease due to source reduction.

Facilities that cited source reduction as a reason for change were also asked to identify the types of source reduction that contributed to the change. Table 4-7 presents the results of this portion of the analysis.

Surprisingly, improved housekeeping and management techniques, considered the easiest and least expensive type of source reduction to implement, were not the most frequently cited. Instead, the most frequently cited form of source reduction was procedure modification. The least frequently cited type of source reduction, excluding the "Other" category, was redesign of product, generally considered one of the more expensive prevention options.

Study participants were not asked to quantify change attributed to each type of source reduction. Thus, although procedure modification was most frequently cited, we cannot conclude that it had the greatest impact on quantity change.

Figure 4-8 shows the percentage of facilities indicating source reduction for each of the nine industry groups studied. Figure 4-9 shows the quantity increase, decrease, and net change attributed to source reduction.

Table 4-7. Percentage of Facilities Implementing Each Type of Source Reduction, by Industry

SIC	Equipment Modification	Procedure Modification	Redesign of Product	Materials Substitution	Improved Management	Other
26	39.2	64.6	30.9	51.0	20.5	10.1
27	30.9	51.8	30.2	38.8	36.0	2.2
28	49.6	62.1	22.3	36.0	54.5	18.3
30	26.4	65.1	17.4	40.4	37.5	11.6
33	57.1	59.2	26.7	47.9	50.7	13.5
34	48.4	61.7	16.1	39.3	55.9	15.3
36	51.3	71.3	11.1	42.6	40.3	9.1
37	49.5	60.6	24.6	49.9	54.2	1.2
Other[a]	65.6	54.2	22.3	40.0	39.3	18.6
Total	52.5	60.3	21.3	41.0	46.1	14.6

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Note: Percentages listed by SIC group represent the number of facilities indicating each type of source reduction divided by the total number of facilities in each SIC group that cited source reduction as a reason for change.

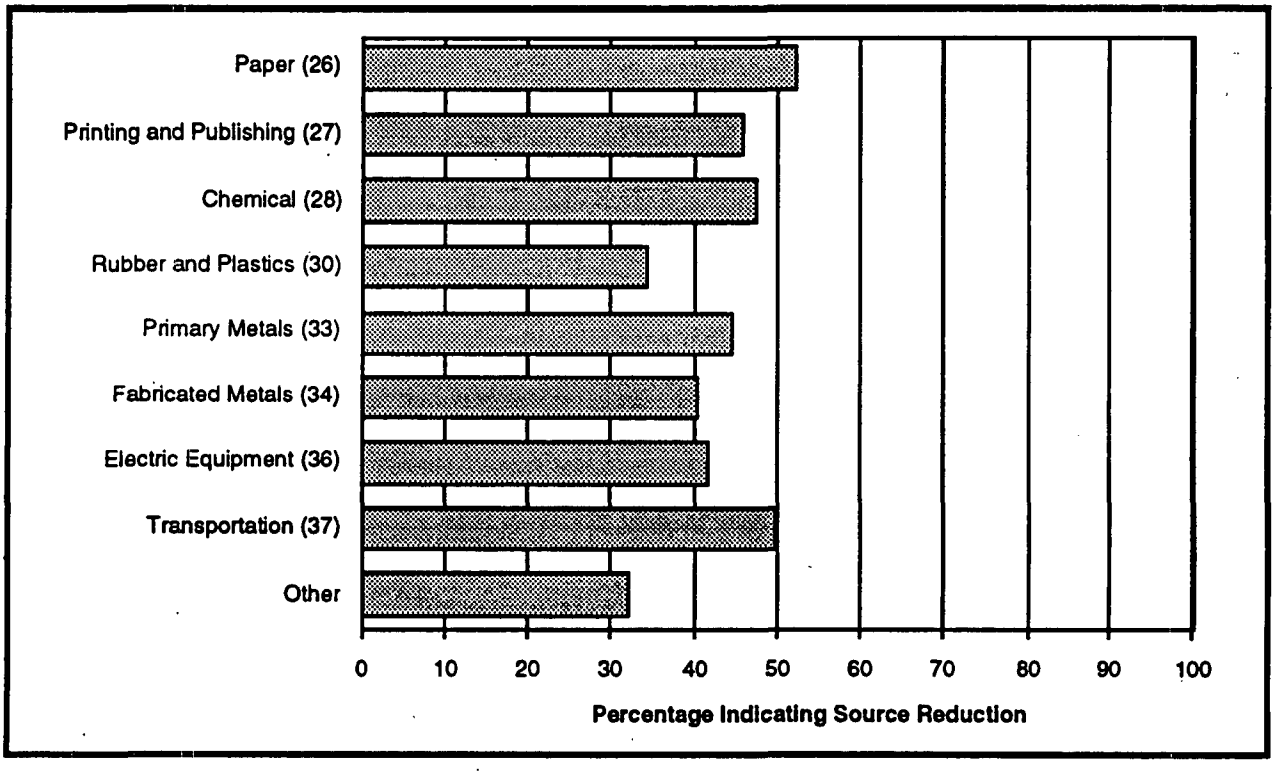

Figure 4-8. Percentage of Facilities Indicating Source Reduction, by Industry

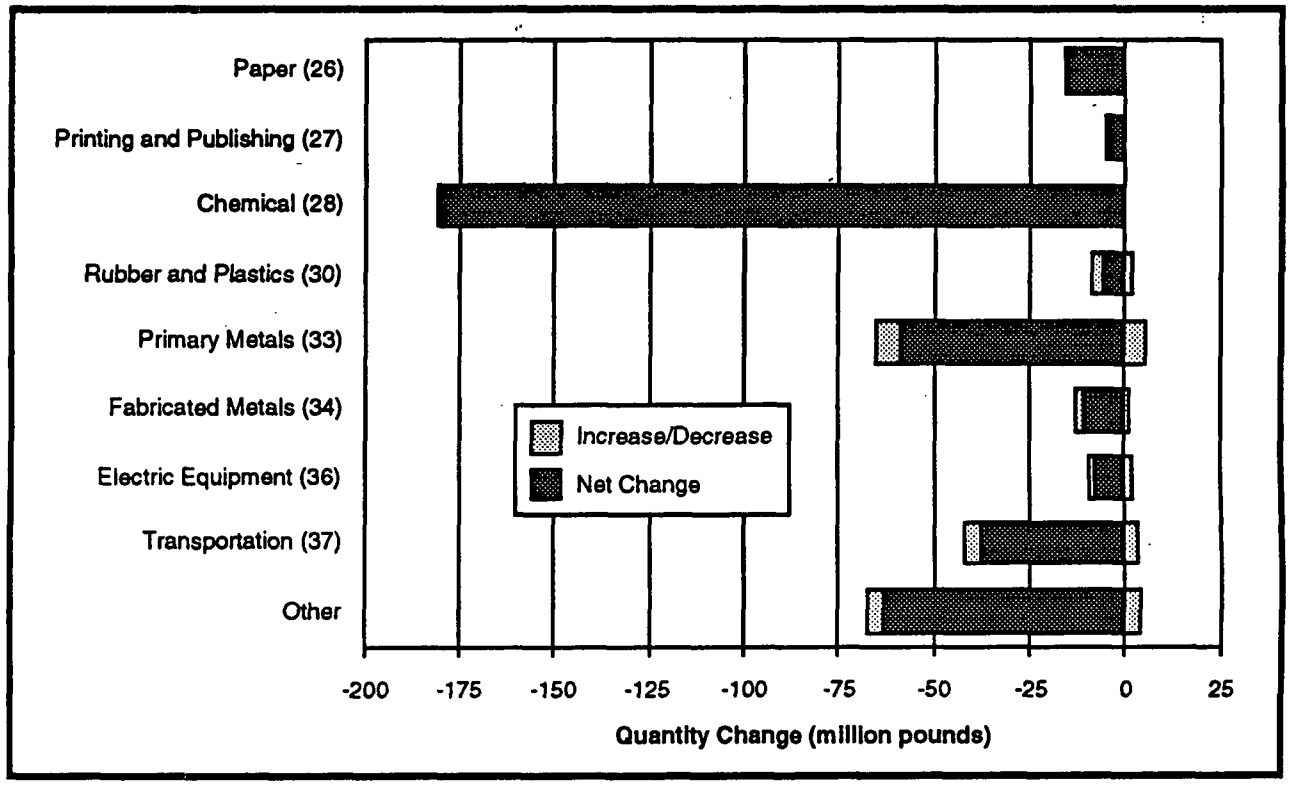

Figure 4-9. Quantity Change Attributed to Source Reduction, by Industry

4.3.4 Other Factors

A net decrease of 416 million pounds or 48 percent of the total change in TRI submissions is due to factors other than the three factors that were the focus of this study. Although study participants were not asked to quantify change due to other reasons, this quantity was estimated by subtracting responses to each of the three change variables from the known quantity change in TRI submissions:

$$\text{Other Factors} = \left(\text{1990 TRI Submissions} - \text{1989 TRI Submissions}\right) - \left(\text{Measurement Change} + \text{Production Change} + \text{Source Reduction}\right)$$

The reasons for change falling under the "Other Factors" category may include, but are not limited to, the following:

- initial TRI data from the EPA data base were not correct;
- facility had revised numbers but had not provided them to EPA;
- respondent made inaccurate estimates;
- respondent was unable or unwilling to estimate the reasons for change;
- CATI interviewer keyed data incorrectly;

- respondents changed their reporting methodology for ammonia and ammonium sulfate; or
- chemical-level data were pulled prior to interview for facilities with more than 20 Form R submissions (see Section 3.2 on data collection procedures).

Data for making quantity estimates are available for four of these reasons. These are listed in Table 4-8 and described below. The remaining quantity falls under the "Unexplained" heading.

Table 4-8. Other Factors Contributing to the Change in 1989-1990 TRI Submissions

Other Factors	Quantity Change (million pounds)
Respondents were unable to quantify change	-290
Facilities changed reporting methodology for ammonia and ammonium sulfate[a]	-250
Respondents claimed their TRI data did not correspond with their submissions[a]	+33
Form Rs were excluded from analysis for facilities with more than 20 TRI chemicals	+1
Unexplained	+90
Total Other Factors	-416

[a]Accuracy of these estimates may be low. Only a handful of facilities took advantage of the ammonia reporting option; thus the desired sample size was not available for making population estimates. Data on TRI discrepancies were collected manually and not part of the computerized script; thus discrepancies may have gone unreported.

Respondents' Ability to Quantify Change

An estimated 12,290 Form Rs, or 14 percent of the population total, attributed some portion of the change to one of the three change variables, but participants were unable to quantify the change. Participants responded positively to one or more of the three reasons and were either unable or unwilling to estimate the quantity change due to that reason. Although this percentage involved only a small portion of the Form Rs, the quantity impact amounted to a net decrease of approximately 290 million pounds.

Table 4-9 shows the percentage of Form Rs for which facilities were able to quantify change by reason. Study participants were not expected to perform additional calculations or estimates in preparation for the interview. Rather, they were asked to provide their best estimates based on existing knowledge. On average, facilities were able to provide quantity estimates for over 80 percent of their Form Rs. The ability to make quantity estimates does not vary significantly between reasons.

Table 4-9. Percentage of Form Rs with Change Quantified, by Industry

SIC	Industry	Measurement Change	Production Change	Source Reduction
26	Paper	90.8	74.7	77.2
27	Printing and publishing	65.5	83.6	73.1
28	Chemical	79.8	77.2	80.9
30	Rubber and plastics	91.8	83.2	83.5
33	Primary metals	88.7	71.5	78.5
34	Fabricated metals	76.1	79.9	82.0
36	Electric Equipment	85.2	64.4	87.6
37	Transportation	67.4	76.2	83.5
	Other[a]	92.9	75.3	73.5
	Total	85.4	75.9	79.3

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Change in Reporting Requirements

The only change in reporting requirements between 1989 and 1990 that would significantly affect the change in releases between the two years was the delisting of terephthalic acid. To prevent this reporting change from influencing this study, terephthalic acid was excluded from the study population.

However, EPA issued technical guidance on the 1990 reporting of ammonia and ammonium sulfate, which had a significant impact on the study results. An estimated decrease or "paper" change of 250 million pounds is attributed to the technical guidance. Approximately 93 percent of this change is the result of a handful of very large facilities in the chemical industry (SIC 28) taking advantage of this reporting option.

TRI Data Discrepancies

As part of the telephone interview process, interviewers were instructed to take note of any Form R data which study participants claimed did not correspond with their submissions. The results indicate that less than 2 percent of all Form Rs had discrepancies. These errors contributed to a net increase in releases and transfers of roughly 33 million pounds.

Form Rs Excluded for Large Facilities

Sampled facilities that submitted more than 20 TRI Form Rs in either 1989 or 1990 were not asked to complete the series of interview questions for all of their TRI chemicals. Instead, in an effort to limit the time required to complete the review, these facilities were asked to explain the reasons for change for those Form Rs making up 80 percent of their total change. The remaining Form Rs were excluded from the review but not from the study population. Thus, their quantity change fell into the "Other Factors" category.

A weighted total of 3,262 Form Rs, or less than 4 percent of the population total, were excluded from the review process. These Form Rs accounted for an estimated net increase in releases and transfers of 1 million pounds.

4.4 ANALYSIS OF RESULTS, BY SIZE STRATA

Facilities with the very large releases and transfers of TRI chemicals can disproportionately influence aggregate quantities of TRI submissions. To study the impact of very large facilities on the quantity change in TRI submissions between 1989 and 1990, a census of the five facilities with the largest increases and the five facilities with the largest decreases for each industry group was included in this review. The results of their responses are discussed below. In addition, population estimates of the reasons for change, with the impact of very large facilities removed, are also provided.

4.4.1 Largest Increase/Decrease Strata

The 90 facilities with the largest increases and decreases combined had a net decrease in TRI submissions of 201 million pounds, or 23 percent of the net change for the population. Disaggregated, this group contributed to 41 percent of the increases and 34 percent of the decreases for the study population (18,951 facilities). Tables 4-10 through 4-12 present the net quantity change, quantity increase and quantity decrease by reasons for change for these strata.

Table 4-10. Largest Increases/Decreases Strata: Net Quantity Change Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Change
26	5.2	10.9	-1.1	-24.5	-9.5
27	-1.8	1.4	0.0	-1.7	-2.2
28	12.8	3.4	-26.1	-201.8	-211.8
30	0.0	2.3	-1.0	-8.2	-6.8
33	-13.7	34.1	-6.1	33.3	47.6
34	-1.1	-1.0	0.5	-0.9	-2.5
36	-0.6	0.5	-1.1	-2.1	-3.3
37	5.8	-3.9	-2.3	2.8	2.4
Other[a]	-0.6	-6.5	-7.8	0.1	-14.8
Total	6.1	41.0	-45.0	-203.0	-200.9

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Table 4-11. Largest Increases/Decreases Strata: Quantity Increase Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Change
26	14.6	10.9	0.0	7.4	32.9
27	0.6	1.4	0.0	0.8	2.7
28	12.8	6.3	0.0	176.6	195.7
30	0.0	2.4	1.7	5.5	9.6
33	0.0	36.4	0.0	178.2	214.6
34	0.0	0.7	0.5	2.8	4.0
36	0.1	0.6	0.1	4.7	5.4
37	5.8	0.1	0.1	5.9	11.8
Other[a]	0.0	0.7	0.0	15.7	16.4
Total	33.8	59.3	2.4	397.5	493.1
Percentage Increase	7%	12%	0%	81%	100%
Percentage of Population Increase	41%	26%	11%	45%	41%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Table 4-12. Largest Increases/Decreases Strata: Quantity Decrease Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Change
26	-9.4	-0.1	-1.1	-31.9	-42.4
27	-2.4	0.0	0.0	-2.5	-4.9
28	0.0	-2.9	-26.1	-378.5	-407.5
30	0.0	-0.1	-2.7	-13.6	-16.4
33	-13.7	-2.3	-6.1	-144.9	-167.0
34	-1.1	-1.7	0.0	-3.6	-6.5
36	-0.6	-0.1	-1.2	-6.8	-8.8
37	0.0	-4.0	-2.4	-3.0	-9.4
Other[a]	-0.6	-7.2	-7.8	-15.6	-31.2
Total	-27.8	-18.3	-47.3	-600.5	-693.9
Percentage Decrease	4%	3%	7%	87%	100%
Percentage of Population Decrease	27%	7%	12%	47%	34%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

A much greater portion of change for the largest increase/decrease strata was attributed to factors other than measurement change, production change, and source reduction than for the population as a whole. An estimated net decrease of 203 million pounds (an increase of 398 million pounds and a decrease of 600 million pounds) was attributed to other factors. This quantity represents nearly 50 percent of the population's net change due to other factors.

Further analysis of the "Other Factors" category revealed that a change in reporting methodology for ammonia and ammonium sulfate accounted for a large portion of the total quantity change due to other factors. Though only a handful of facilities apparently took advantage of this reporting option, the impact was significant. For example, a single facility in the chemical industry (SIC 28) had a net decrease in TRI submissions for ammonia and ammonium sulfate of 142 million pounds. Most of the facilities that reported this paper change were from SIC 28 of the largest decreases strata.

4.4.2 Population Estimates with Largest Increase/Decrease Strata Removed

Because the relatively small number of facilities of the largest increases/decreases strata had a disproportionately large impact on the total reported quantity change in TRI submissions, viewing the population estimates with these strata removed gives a better sense of how "average" facilities explained their change. Tables 4-13 through 4-15 show these results by net quantity change, quantity increase, and quantity decrease.

The total quantity decrease accounted for by this subset of the population is 665 million pounds, or 77 percent of the study population's total change. The percentage quantity change due to source reduction is 52 percent, which is 7 percentage points higher than the total study population estimate. The percentage change due to other factors is only 32 percent, which is 16 percentage points lower than the total study population estimate. The primary reason for the percentage decrease in quantity due to other factors is the reduction in quantity change due to the ammonium sulfate paper change, which was most prominent in the largest increases/decreases strata.

Table 4-13. Population Estimates with the Largest Increase/Decrease Strata Removed: Net Quantity Change Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Change
26	1.1	1.2	-15.2	-9.3	-22.0
27	-0.2	-0.5	-5.3	1.3	-4.7
28	0.0	-102.7	-154.8	-128.3	-385.9
30	2.5	5.0	-4.9	-9.3	-6.7
33	-1.2	22.5	-52.8	-27.1	-58.6
34	-5.3	7.4	-11.5	-10.6	-20.0
36	1.7	-0.4	-6.6	-14.6	-19.9
37	3.9	-2.6	-35.5	-3.2	-37.5
Other[a]	-30.4	-12.2	-55.7	-11.6	-109.9
Total Change	-28.0	-82.2	-342.3	-212.7	-665.1
Percentage Change	4%	12%	52%	32%	100%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Table 4-14. Population Estimates with the Largest Increase/Decrease Strata Removed: Quantity Increase Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Increase
26	10.3	8.6	0.1	9.4	28.4
27	0.1	1.0	0.1	3.4	4.6
28	5.1	40.4	0.2	243.3	288.9
30	2.7	11.5	0.9	19.6	34.8
33	3.2	42.7	6.2	39.0	91.2
34	2.6	25.6	1.2	23.3	52.6
36	2.7	5.3	2.1	15.3	25.3
37	6.1	8.9	3.7	22.5	41.2
Other[a]	15.8	23.2	4.4	101.9	145.3
Total Increase	48.6	167.2	18.8	477.6	712.1
Percentage Increase	7%	24%	3%	67%	100%
Percentage of Population Increase	59%	74%	89%	55%	59%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

Table 4-15. Population Estimates with the Largest Increase/Decrease Strata Removed: Quantity Decrease Attributed to Each Reason, by Industry (million pounds)

SIC	Measurement Change	Production Change	Source Reduction	Other Factors	Total Decrease
26	-9.2	-7.4	-15.2	-18.6	-50.4
27	-0.3	-1.5	-5.4	-2.0	-9.3
28	-5.1	-143.1	-155.0	-371.5	-674.7
30	-0.2	-6.5	-5.9	-28.9	-41.4
33	-4.5	-20.2	-59.0	-66.2	-149.8
34	-7.9	-18.2	-12.7	-33.9	-72.7
36	-0.9	-5.7	-8.7	-29.9	-45.2
37	-2.2	-11.5	-39.2	-25.7	-78.6
Other[a]	-46.2	-35.4	-60.1	-113.5	-255.2
Total Decrease	-76.5	-249.3	-361.1	-690.3	-1,377.2
Percentage Decrease	6%	18%	26%	50%	100%
Percentage of Population Decrease	73%	93%	88%	53%	66%

[a]Includes all other industries between 20 and 39 and facilities with more than one 2-digit SIC code between 20 and 39.

CHAPTER 5
CONCLUSIONS

This chapter summarizes the results of the study and makes recommendations for future studies of TRI data submissions.

5.1 SUMMARY OF RESULTS

The results of this study provide insight on the reasons for changes in TRI submissions between 1989 and 1990. At least 50 percent of the net change reported represents a *real* change in the physical quantity of chemicals released (i.e., production change and source reduction). The remaining net quantity change results in part from reporting or paper changes and from other real and paper changes not covered by our review.

This study also serves as a first step in measuring source reduction progress. Results can be used as a baseline for comparison with Pollution Prevention Act data collected as part of the 1991 Form R reporting. With these new data, EPA will be better able to track and evaluate source reduction progress from year to year. This type of longitudinal study is critical for accurately assessing reduction progress because the effects of many prevention activities may not be evident for several years after implementation.

The most significant findings from this study are highlighted below:

- ***Source reduction activities resulted in a significant reduction of TRI releases and transfers.*** Approximately 40 percent of all facilities attributed some portion of their change to source reduction. The estimated net decrease resulting from source reduction activities was 387 million pounds, or 45 percent of the total net decrease. This total represents the sum of a 21 million pound increase and a 408 million pound decrease, or 2 percent of the total quantity increase and 20 percent of the total quantity decrease.

- ***Production fluctuation was the most frequently cited reason for change and accounted for the largest absolute change.*** Nearly 70 percent of all facilities attributed some portion of their change to production-level changes. The quantity decrease resulting from production fluctuation was 268 million pounds which was only slightly higher than the 227 million pound quantity increase. Because these two cancelled each other out, the net impact of production change was relatively low, accounting for only 5 percent of the total net change.

- ***Changes in measurement techniques had a relatively small impact.*** Only 24 percent of all facilities claimed a reporting change due to changes in their measurement or estimation techniques. An increase of 82 million pounds and a decrease of 104 million pounds were attributed to measurement change. This resulted in a net quantity decrease of 22 million pounds, or less than 3 percent of the total net change.

- ***Reported changes include significant amounts of both increases and decreases.*** The aggregate or net quantity change may mask the true impact of each factor because quantity increases and decreases cancel each other out. Production change, for

example, had a relatively small net decrease of 41 million pounds, yet it had the greatest absolute change. Nearly 500 million pounds in increases and decreases were the result of production fluctuations. This illustrates the importance of examining quantity increases separately from quantity decreases.

- ***Most facilities are able to distinguish real from paper changes.*** Study participants were asked to make quantity estimates based on existing knowledge. They were not expected to perform additional calculations or estimates in preparation for the interview. Still, respondents were able to provide estimates of the quantity change due to measurement change, production change, and source reduction for approximately 80 percent of their Form Rs. Surprisingly, the ability to make quantity estimates did not vary significantly between reasons.

- ***Accuracy of estimates distinguishing real from paper changes may be low.*** Many of the study participants made estimates of quantity change by reason for the first time, and many based these estimates on best judgment as opposed to engineering calculations or measurements. Consequently, accuracy may be low. Similarly, data quality for the Pollution Prevention Act data now required in Form R reporting may be low for the first years of reporting these new data elements. This should be taken into account when assessing progress from year to year.

- ***Many factors, both real and reporting changes, affect TRI submissions.*** This study focused on the extent to which three factors—measurement change, production change, and source reduction—affected TRI submissions. Although these variables accounted for a large portion of the total change, approximately 48 percent of the total change was due to other factors, such as recycling, one-time spills/accidents, company shutdowns, and technical guidance. To fully explain the quantity change in TRI submissions, many variables would have to be investigated.

5.2 RECOMMENDATIONS FOR FUTURE RESEARCH

The Pollution Prevention Act data will provide useful information for assessing changes in reported TRI submissions, such as the impact of source reduction activities, changes in estimation and accounting methods, and production ratios. However, EPA's understanding of changes in TRI submission data will still be limited. As the results of this study show, numerous reasons explain TRI reporting changes, only a fraction of which are covered by the Form R. Also, some reporting options, such as the ammonia/ammonium sulfate reporting option, are unique to each reporting year. Therefore, the Pollution Prevention Act data cannot completely substitute for seeking additional details from industry.

Future research involving direct contact with industry representatives can provide important insight on how facilities are modifying their practices to reduce releases of TRI chemicals. As a result of this study, the following enhancements are recommended for future studies of changes in TRI submissions:

- ***Ask participants to explain the total quantity change for each Form R submission.*** Ideally, the questions covered by the review should form an equation with the sum of responses equalling the total change in TRI submissions. This format would improve

the accuracy of study results and reduce the quantity change falling under the "Other Factors" category. The easiest way to collect the data would be with a written questionnaire. Many of the participants in this study said they would prefer a questionnaire to the telephone interview process.

- ***Consider additional source reduction questions.*** Participants in this study claiming to have source reduction programs were asked to estimate the quantity impact of these programs and to identify the types of source reduction activities implemented. Because realizing the results of reduction programs may take several years, asking participants when their programs were implemented and when they first saw or expected to see results would be helpful. In addition, knowing which types of source reduction activities proved most effective would be helpful.

- ***Consider other criteria for the sampling design.*** The sampling plan for this study was designed at the facility level with equal allocation across industry and change strata. The same sampling design could be used with the Form R, instead of the facility, as the unit of selection. This design would be a more accurate way of making selections by change strata (because a facility in the increase strata could have many Form Rs showing decreases and only one Form R with a very large increase that outweighs the decreases). Sampling at the Form-R level allows specific chemicals such as 33/50 chemicals to be selected for review. Other sampling criteria, such as geographic region, size of facility, and toxicity of chemicals, should be considered, depending on Agency requirements and objectives.

- ***Consider selecting other groups to be censused.*** For this study facilities with the largest increases and decreases in TRI submissions were censused to identify the factors influencing these large quantity changes. Depending on the type of analysis desired, selecting a different subset of facilities to be censused may be helpful. For example, using the Pollution Prevention Act data, the review could census facilities reporting the greatest quantity change (absolute and/or relative) due to source reduction. These facilities, with proven success in source reduction, may be able to provide recommendations and serve as examples for other facilities in their industries. These facilities may also be good candidates for EPA's proposed Environmental Leadership Program.

- ***Conduct further studies on the effects of materials substitution.*** Study participants claimed an increase due to source reduction for over 7 percent of their Form Rs affected by source reduction. The most common reason for this increase was materials substitution whereby facilities substituted one (presumably less toxic) chemical for another. It would be helpful to assess the characteristics (e.g. risk, hazard) and relative quantities of the substitute chemicals.

Appendix A

Mail-Out Materials

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 29 1992

OFFICE OF
PESTICIDES AND TOXIC
SUBSTANCES

Dear TRI Technical Contact:

Research Triangle Institute (RTI), a not-for-profit research institution in North Carolina, has a Cooperative Agreement with EPA's Office of Pollution Prevention and Toxics (OPPT) to conduct research on economic and related methods for improving environmental quality. As part of this research effort, RTI is reviewing changes in data submitted under Section 313 of the Superfund Amendments and Reauthorization Act (SARA), also known as the Community Right-to-Know Act. These data are referred to as the Toxic Release Inventory (TRI).

As part of this research effort, RTI is seeking to clarify changes reported in TRI data between 1989 and 1990 that were due to:

- changes in estimation/measurement methods;
- changes in the level of production activity; or
- changes in other related factors.

This facility has been randomly selected to participate in this review. Your participation in this review is voluntary. In addition, you are not expected to conduct additional measurement activity; instead, we would like your best estimate based on your 1989 and 1990 submissions.

A representative of RTI will telephone you to review changes in your TRI data. You can expect to be contacted after **June 18, 1992.** For your convenience in responding to this review, we have included with this letter copies of the TRI data we currently have for this facility for 1989 and 1990.

RTI will compile the information collected in this review into a summary report for EPA. If you are interested in obtaining a copy of this report, please notify the RTI telephone interviewer and we will send it to you when it becomes available.

If you have any questions about this review, please call Rachel Baker at RTI at (919) 541-5847, or Eun-Sook Goidel at EPA at (202)260-3296.

Thank you for your help in completing this review.

Sincerely,

Gerald F. Kotas
Director, Pollution Prevention Division

Attachment(s)

Current TRI Data for 1989 and 1990, by Chemical

Facility Name: ACME CHEMICALS, INC.
TRI ID Number: 00617ACMCHROAD9

Chemical name: FREON 113
CAS number: 000076131

Type of Releases or Transfer	1990 Quantity (pounds) [a]	1989 Quantity (pounds) [a]	Change (pounds) [b]
Fugitive or non-point air emissions	32,770	12,104	20,666
Stack or point air emissions	0	0	0
Discharges to water bodies	0	0	0
Underground injection on-site	0	0	0
Releases to land	0	0	0
Discharge to POTW	0	2,339	-2,339
Transfers to other off-site locations	11,519	107	11,412
Total Releases and Transfers	44,289	14,550	29,739

[a] *Quantities reported as ranges are shown as follows:*
range 1 to 10 pounds ..... 5 pounds
range 11 to 499 pounds ..... 250 pounds
range 1 to 499 pounds ..... 250 pounds
range 500 to 999 pounds ..... 750 pounds

[b] *Change = 1990 quantity - 1989 quantity*

Current TRI Data for 1989 and 1990, by Chemical

Facility Name: ACME CHEMICALS, INC.
TRI ID Number: 00617ACMCHROAD9

Chemical name: ETHYLENE OXIDE
CAS number: 000075218

Type of Releases or Transfer	1990 Quantity (pounds) [a]	1989 Quantity (pounds) [a]	Change (pounds) [b]
Fugitive or non-point air emissions	1,870	6,800	-4,930
Stack or point air emissions	748	2,720	-1,972
Discharges to water bodies	0	0	0
Underground injection on-site	0	0	0
Releases to land	0	0	0
Discharge to POTW	2,783	10,118	-7,335
Transfers to other off-site locations	0	0	0
Total Releases and Transfers	5,401	19,638	-14,237

[a] *Quantities reported as ranges are shown as follows:*
range 1 to 10 pounds ..... 5 pounds
range 11 to 499 pounds ..... 250 pounds
range 1 to 499 pounds ..... 250 pounds
range 500 to 999 pounds ..... 750 pounds

[b] *Change = 1990 quantity - 1989 quantity*

Current TRI Data for 1989 and 1990, by Chemical

Facility Name: ACME CHEMICALS, INC.
TRI ID Number: 00617ACMCHROAD9

Chemical name: 1,1,1-TRICHLOROETHANE
CAS number: 000071556

Type of Releases or Transfer	1990 Quantity (pounds) [a]	1989 Quantity (pounds) [a]	Change (pounds) [b]
Fugitive or non-point air emissions	8,900	18,000	-9,100
Stack or point air emissions	3,800	7,600	-3,800
Discharges to water bodies	0	0	0
Underground injection on-site	0	0	0
Releases to land	0	0	0
Discharge to POTW	0	0	0
Transfers to other off-site locations	0	0	0
Total Releases and Transfers	12,700	25,600	-12,900

[a] *Quantities reported as ranges are shown as follows:*
range 1 to 10 pounds ..... 5 pounds
range 11 to 499 pounds ..... 250 pounds
range 1 to 499 pounds ..... 250 pounds
range 500 to 999 pounds ..... 750 pounds

[b] *Change = 1990 quantity - 1989 quantity*

Appendix B

Interview Script

Script for TRI Study

Hello, can I speak with *contact person* please?

If not. When would be a convenient time for me to call back?

Hello, this is _____ with Research Triangle Institute. We're a not-for-profit research institute in North Carolina. We're conducting a research study under a cooperative agreement with EPA. As part of this research effort, we're studying changes in data submitted under Section 313 of the Superfund Amendments and Reauthorization Act, or SARA, also known as the Community Right-to-Know Act. These data are referred to as the Toxic Release Inventory, or TRI.

Your facility has been randomly selected to participate in this research effort. Your participation in this study is voluntary. You should have received a letter from EPA explaining this research study. Did you receive this letter?

If not. I'd like to send you a second copy of the letter. Could I get your mailing address, please?

We'd like to ask you a few questions about your TRI submissions. Is now a convenient time?

If not. What would be a good time for me to call you back?

Great. The letter we sent included copies of the TRI data we have for your facility. You might want to pull out these data. It should make answering these questions a little easier.

I just have a few questions about each chemical for which you submitted TRI data. In each question, I'll ask about changes between 1989 and 1990 in your releases and transfers of each chemical. Please give me your best estimate based on whatever information you have available; you are not expected to conduct any additional measurement activities.

Let's take a look at the first chemical I have, *chemical name*.

For *chemical name*, did your facility change the estimation or measurement method it used to calculate its TRI submissions between 1989 and 1990?

If yes. What's your best estimate of the change in the quantity of *chemical name* reported in TRI that was due to your change in estimation method?

Is this an increase or decrease?

For *chemical name*, did your facility have a change in production levels that changed the quantity of this chemical released or transferred between 1989 and 1990?

If yes. What's your best estimate of the change in the quantity of *chemical name* released or transferred that was due to your change in production levels?

Is this an increase or decrease?

(Source reduction is any action or technique that reduces or eliminates the amount of a toxic chemical entering wastestreams or released directly to the environment. Source reduction activities do not include actions taken to recycle, treat, energy recover, or dispose of a toxic chemical once it has entered a wastestream.)

Did your facility's releases and transfers of *chemical name* change between 1989 and 1990 due to source reduction activities?

If yes. Which of the following types of source reduction activities were implemented for *chemical name* ?

a. equipment or technology modification
b. process or procedure modification
c. reformulation or redesign of products
d. substitution of raw materials
e. improvement in housekeeping, maintenance, training, or inventory control
f. other source reduction activity

If yes. What's your best estimate of the change in the quantity of *chemical name* released or transferred that was due to source reduction?

Is this an increase or decrease?

Now I'd like to look at your next TRI chemical, *chemical name* . *(Continue asking questions for all chemicals).*

That's it for my questions. Thank you for your time and help. If you have any further questions about this study, please feel free to call either the EPA or RTI contact listed on the letter you received. Good Bye.

Appendix C

1989 Form Rs

Form Approved OMB No.: 2070-0093

Approval Expires: 01 91

(Important: Type or print; read instructions before completing form.)

EPA U.S. Environmental Protection Agency

TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as Title III of the Superfund Amendments and Reauthorization Act

EPA FORM R

PART I. FACILITY IDENTIFICATION INFORMATION

(This space for your optional use.)

1. 1.1 Are you claiming the chemical identity on page 3 trade secret? [ ] Yes (Answer question 1.2; Attach substantiation forms.) [ ] No (Do not answer 1.2; Go to question 1.3.)

1.2 If "Yes" in 1.1, is this copy: [ ] Sanitized [ ] Unsanitized

1.3 Reporting Year 19____

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official

Signature | Date signed

3. FACILITY IDENTIFICATION

3.1

Facility or Establishment Name

Street Address

City | County

State | Zip Code

TRI Facility Identification Number

WHERE TO SEND COMPLETED FORMS:

1. EPCRA REPORTING CENTER
   P.O. BOX 23779
   WASHINGTON, DC 20026-3779
   ATTN: TOXIC CHEMICAL RELEASE INVENTORY

2. APPROPRIATE STATE OFFICE (See instructions in Appendix G)

3.2 This report contains information for (Check only one): a. [ ] An entire facility b. [ ] Part of a facility.

3.3 Technical Contact | Telephone Number (include area code)

3.4 Public Contact | Telephone Number (include area code)

3.5 SIC Code (4 digit) a. | b. | c. | d. | e. | f.

3.6

Latitude			Longitude		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

3.7 Dun & Bradstreet Number(s) a. | b.

3.8 EPA Identification Number(s) (RCRA I.D. No.) a. | b.

3.9 NPDES Permit Number(s) a. | b.

3.10 Receiving Streams or Water Bodies (enter one name per box) a. | b. | c. | d. | e. | f.

3.11 Underground Injection Well Code (UIC) Identification Number(s) a. | b.

4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company | **4.2** Parent Company's Dun & Bradstreet Number

(Important: Type or print; read instructions before completing form.)

EPA

EPA FORM R
PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

(This space for your optional use.)

1. PUBLICLY OWNED TREATMENT WORKS (POTWs)

1.1 POTW name		1.2 POTW name	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip

2. OTHER OFF-SITE LOCATIONS (DO NOT REPORT LOCATIONS TO WHICH WASTES ARE SENT ONLY FOR RECYCLING OR REUSE).

2.1 Off-site location name		2.2 Off-site location name	
EPA Identification Number (RCRA ID. No.)		EPA Identification Number (RCRA ID. No.)	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip
Is location under control of reporting facility or parent company? [ ] Yes [ ] No		Is location under control of reporting facility or parent company? [ ] Yes [ ] No	

2.3 Off-site location name		2.4 Off-site location name	
EPA Identification Number (RCRA ID. No.)		EPA Identification Number (RCRA ID. No.)	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip
Is location under control of reporting facility or parent company? [ ] Yes [ ] No		Is location under control of reporting facility or parent company? [ ] Yes [ ] No	

2.5 Off-site location name		2.6 Off-site location name	
EPA Identification Number (RCRA ID. No.)		EPA Identification Number (RCRA ID. No.)	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip
Is location under control of reporting facility or parent company? [ ] Yes [ ] No		Is location under control of reporting facility or parent company? [ ] Yes [ ] No	

[ ] Check if additional pages of Part II are attached. How many? _____

EPA

EPA FORM R

PART III. CHEMICAL-SPECIFIC INFORMATION

(This space for your optional use.)

1. CHEMICAL IDENTITY (Do not complete this section if you complete Section 2.)

1.1	[Reserved]
1.2	CAS Number (Enter only one number exactly as it appears on the 313 list. Enter NA if reporting a chemical category.)
1.3	Chemical or Chemical Category Name (Enter only one name exactly as it appears on the 313 list.)
1.4	Generic Chemical Name (Complete only if Part I, Section 1.1 is checked "Yes." Generic name must be structurally descriptive.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you complete Section 1.)

2. Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation).)

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1	Manufacture the chemical:	a. [ ] Produce	b. [ ] Import	If produce or import: c. [ ] For on-site use/processing	e. [ ] As a byproduct	d. [ ] For sale/ distribution; f. [ ] As an impurity
3.2	Process the chemical:	a. [ ] As a reactant	d. [ ] Repackaging only	b. [ ] As a formulation component		c. [ ] As an article component
3.3	Otherwise use the chemical:	a. [ ] As a chemical processing aid		b. [ ] As a manufacturing aid		c. [ ] Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON-SITE AT ANY TIME DURING THE CALENDAR YEAR

[ ][ ] (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT ON-SITE

You may report releases of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)		A. Total Release (pounds/year) A.1 Reporting Ranges 0 / 1–499 / 500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1 Fugitive or non-point air emissions	5.1a	[ ] [ ] [ ]		5.1b [ ]	
5.2 Stack or point air emissions	5.2a	[ ] [ ] [ ]		5.2b [ ]	
5.3 Discharges to receiving streams or water bodies (Enter letter code for stream from Part I Section 3.10 in the box provided.) 5.3.1 [ ]	5.3.1a	[ ] [ ] [ ]		5.3.1b [ ]	5.3.1c %
5.3.2 [ ]	5.3.2a	[ ] [ ] [ ]		5.3.2b [ ]	5.3.2c %
5.3.3 [ ]	5.3.3a	[ ] [ ] [ ]		5.3.3b [ ]	5.3.3c %
5.4 Underground injection on-site	5.4a	[ ] [ ] [ ]		5.4b [ ]	
5.5 Releases to land on-site 5.5.1 Landfill	5.5.1a	[ ] [ ] [ ]		5.5.1b [ ]	
5.5.2 Land treatment/application farming	5.5.2a	[ ] [ ] [ ]		5.5.2b [ ]	
5.5.3 Surface impoundment	5.5.3a	[ ] [ ] [ ]		5.5.3b [ ]	
5.5.4 Other disposal	5.5.4a	[ ] [ ] [ ]		5.5.4b [ ]	

[ ] (Check if additional information is provided on Part IV–Supplemental Information.)

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PART III. CHEMICAL-SPECIFIC INFORMATION (continued)

(This space for your optional use.)

6. TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)	A. Total Transfers (pounds/year) A.1 Reporting Ranges 0 / 1–499 / 500–999	A. Total Transfers (pounds/year) A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
6.1.1 Discharge to POTW (enter location number from Part II, Section 1.) 1	[ ] [ ] [ ]		6.1.1b	
6.2.1 Other off-site location (enter location number from Part II, Section 2.) 2	[ ] [ ] [ ]		6.2.1b	6.2.1c M
6.2.2 Other off-site location (enter location number from Part II, Section 2.) 2	[ ] [ ] [ ]		6.2.2b	6.2.2c M
6.2.3 Other off-site location (enter location number from Part II, Section 2.) 2	[ ] [ ] [ ]		6.2.3b	6.2.3c M

[ ] (Check if additional information is provided on Part IV-Supplemental Information.)

7. WASTE TREATMENT METHODS AND EFFICIENCY

[ ] Not Applicable (NA) – Check if no on-site treatment is applied to any wastestream containing the chemical or chemical category.

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes / No
7.1a	7.1b	7.1c	7.1d [ ]	7.1e %	7.1f [ ] [ ]
7.2a	7.2b	7.2c	7.2d [ ]	7.2e %	7.2f [ ] [ ]
7.3a	7.3b	7.3c	7.3d [ ]	7.3e %	7.3f [ ] [ ]
7.4a	7.4b	7.4c	7.4d [ ]	7.4e %	7.4f [ ] [ ]
7.5a	7.5b	7.5c	7.5d [ ]	7.5e %	7.5f [ ] [ ]
7.6a	7.6b	7.6c	7.6d [ ]	7.6e %	7.6f [ ] [ ]
7.7a	7.7b	7.7c	7.7d [ ]	7.7e %	7.7f [ ] [ ]
7.8a	7.8b	7.8c	7.8d [ ]	7.8e %	7.8f [ ] [ ]
7.9a	7.9b	7.9c	7.9d [ ]	7.9e %	7.9f [ ] [ ]
7.10a	7.10b	7.10c	7.10d [ ]	7.10e %	7.10f [ ] [ ]

[ ] (Check if additional information is provided on Part IV-Supplemental Information.)

8. POLLUTION PREVENTION: OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of Modification (enter code)	B. Quantity of the Chemical in Wastes Prior to Treatment or Disposal: Current reporting year (pounds/year)	Prior year (pounds/year)	Or percent change (Check (+) or (-))	C. Index	D. Reason for Action (enter code)
M	_____	_____	[ ] + [ ] - _____ %	[ ] [ ]	R

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PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Part III. Number the lines used sequentially from lines in prior sections (e.g., 5.3.4, 6.1.2, 7.11)

(This space for your optional use.)

ADDITIONAL INFORMATION ON RELEASES OF THE CHEMICAL TO THE ENVIRONMENT ON-SITE (Part III, Section 5.3)

You may report releases of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)		A. Total Release (pounds/year) A.1 Reporting Ranges 0 / 1-499 / 500-999	A.2 Enter Estimate	B. Basis of Estimate (enter code in box provided)	C. % From Stormwater
5.3 Discharges to receiving streams or water bodies 5.3.___ [ ]	5.3.___a	[ ] [ ] [ ]		5.3.___b [ ]	5.3.___c %
(Enter letter code for stream from Part I Section 3.10 in the box provided.) 5.3.___ [ ]	5.3.___a	[ ] [ ] [ ]		5.3.___b [ ]	5.3.___c %
5.3.___ [ ]	5.3.___a	[ ] [ ] [ ]		5.3.___b [ ]	5.3.___c %

ADDITIONAL INFORMATION ON TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS (Part III, Section 6)

You may report transfers of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)	A. Total Transfers (pounds/year) A.1 Reporting Ranges 0 / 1-499 / 500-999	A.2 Enter Estimate	B. Basis of Estimate (enter code in box provided)	C. Type of Treatment/ Disposal (enter code in box provided)
6.1.___ Discharge to POTW (enter location number from Part II, Section 1.) [1].[ ]	[ ] [ ] [ ]		6.1.___b [ ]	
6.2.___ Other off-site location (enter location number from Part II, Section 2.) [2].[ ]	[ ] [ ] [ ]		6.2.___b [ ]	6.2.___c [M][ ][ ]
6.2.___ Other off-site location (enter location number from Part II, Section 2.) [2].[ ]	[ ] [ ] [ ]		6.2.___b [ ]	6.2.___c [M][ ][ ]
6.2.___ Other off-site location (enter location number from Part II, Section 2.) [2].[ ]	[ ] [ ] [ ]		6.2.___b [ ]	6.2.___c [M][ ][ ]

ADDITIONAL INFORMATION ON WASTE TREATMENT METHODS AND EFFICIENCY (Part III, Section 7)

A. General Wastestream (enter code in box provided)	B. Treatment Method (enter code in box provided)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes / No
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]

Appendix D

1990 Form Rs

Form Approved OMB No.: 2070-0093

Approval Expires: 01/94

(Important: Type or print; read instructions before completing form.)

EPA U.S. Environmental Protection Agency

TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as Title III of the Superfund Amendments and Reauthorization Act

EPA FORM **R**	PART I. FACILITY IDENTIFICATION INFORMATION	(This space for your optional use.)

1.	1.1 Are you claiming the chemical identity on page 3 trade secret? [ ] Yes (Answer question 1.2; Attach substantiation forms.) [ ] No (Do not answer 1.2; Go to question 1.3.)	1.2 If "Yes" in 1.1, is this copy: [ ] Sanitized [ ] Unsanitized	1.3 Reporting Year 19____

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official

Signature | Date signed

3. FACILITY IDENTIFICATION

3.1
- Facility or Establishment Name
- Street Address
- City | County
- State | Zip Code
- TRI Facility Identification Number

WHERE TO SEND COMPLETED FORMS:

1. EPCRA REPORTING CENTER
   P.O. BOX 23779
   WASHINGTON, DC 20026-3779
   ATTN: TOXIC CHEMICAL RELEASE INVENTORY
2. APPROPRIATE STATE OFFICE (See instructions in Appendix G)

3.2 This report contains information for (Check only one): a. [ ] An entire facility b. [ ] Part of a facility.

3.3 Technical Contact | Telephone Number (include area code)

3.4 Public Contact | Telephone Number (include area code)

3.5 SIC Code (4 digit) a. | b. | c. | d. | e. | f.

3.6

	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

3.7 Dun & Bradstreet Number(s) a. | b.

3.8 EPA Identification Number(s) (RCRA I.D. No.) a. | b.

3.9 NPDES Permit Number(s) a. | b.

3.10 Receiving Streams or Water Bodies (enter one name per box) a. | b. | c. | d. | e. | f.

3.11 Underground Injection Well Code (UIC) Identification Number(s) a. | b.

4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company | 4.2 Parent Company's Dun & Bradstreet Number

(Important: Type or print; read instructions before completing form.)

EPA

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PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

(This space for your optional use.)

1. PUBLICLY OWNED TREATMENT WORKS (POTWs)

1.1 POTW name		1.2 POTW name	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip

2. OTHER OFF-SITE LOCATIONS (DO NOT REPORT LOCATIONS TO WHICH WASTES ARE SENT ONLY FOR RECYCLING OR REUSE).

2.1 Off-site location name		2.2 Off-site location name	
EPA Identification Number (RCRA ID. No.)		EPA Identification Number (RCRA ID. No.)	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip
Is location under control of reporting facility or parent company? [ ] Yes [ ] No		Is location under control of reporting facility or parent company? [ ] Yes [ ] No	

2.3 Off-site location name		2.4 Off-site location name	
EPA Identification Number (RCRA ID. No.)		EPA Identification Number (RCRA ID. No.)	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip
Is location under control of reporting facility or parent company? [ ] Yes [ ] No		Is location under control of reporting facility or parent company? [ ] Yes [ ] No	

2.5 Off-site location name		2.6 Off-site location name	
EPA Identification Number (RCRA ID. No.)		EPA Identification Number (RCRA ID. No.)	
Street Address		Street Address	
City	County	City	County
State	Zip	State	Zip
Is location under control of reporting facility or parent company? [ ] Yes [ ] No		Is location under control of reporting facility or parent company? [ ] Yes [ ] No	

[ ] Check if additional pages of Part II are attached. How many? _____

(Important: Type or print; read instructions before completing form.)

EPA

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PART III. CHEMICAL-SPECIFIC INFORMATION

(This space for your optional use.)

1. CHEMICAL IDENTITY (Do not complete this section if you complete Section 2.)

1.1	[Reserved]
1.2	CAS Number (Enter only one number exactly as it appears on the 313 list. Enter NA if reporting a chemical category.)
1.3	Chemical or Chemical Category Name (Enter only one name exactly as it appears on the 313 list.)
1.4	Generic Chemical Name (Complete only if Part I, Section 1.1 is checked "Yes." Generic name must be structurally descriptive.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you complete Section 1.)

2. Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation).)

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1	Manufacture the chemical:	a. [ ] Produce	b. [ ] Import	If produce or import: c. [ ] For on-site use/processing	e. [ ] As a byproduct	d. [ ] For sale/ distribution f. [ ] As an impurity
3.2	Process the chemical:	a. [ ] As a reactant	d. [ ] Repackaging only	b. [ ] As a formulation component		c. [ ] As an article component
3.3	Otherwise use the chemical:	a. [ ] As a chemical processing aid		b. [ ] As a manufacturing aid		c. [ ] Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON-SITE AT ANY TIME DURING THE CALENDAR YEAR

[ ][ ] (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT ON-SITE

You may report releases of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)

		A. Total Release (pounds/year) A.1 Reporting Ranges 1–10 / 11–499 / 500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1 Fugitive or non-point air emissions	5.1a	[ ] [ ] [ ]		5.1b [ ]	
5.2 Stack or point air emissions	5.2a	[ ] [ ] [ ]		5.2b [ ]	
5.3 Discharges to receiving streams or water bodies (Enter letter code from Part I Section 3.10 for stream(s) in the box provided.) 5.3.1 [ ]	5.3.1a	[ ] [ ] [ ]		5.3.1b [ ]	5.3.1c %
5.3.2 [ ]	5.3.2a	[ ] [ ] [ ]		5.3.2b [ ]	5.3.2c %
5.3.3 [ ]	5.3.3a	[ ] [ ] [ ]		5.3.3b [ ]	5.3.3c %
5.4 Underground injection	5.4a	[ ] [ ] [ ]		5.4b [ ]	
5.5 Releases to land					
5.5.1 On-site landfill	5.5.1a	[ ] [ ] [ ]		5.5.1b [ ]	
5.5.2 Land treatment/application farming	5.5.2a	[ ] [ ] [ ]		5.5.2b [ ]	
5.5.3 Surface impoundment	5.5.3a	[ ] [ ] [ ]		5.5.3b [ ]	
5.5.4 Other disposal	5.5.4a	[ ] [ ] [ ]		5.5.4b [ ]	

[ ] (Check if additional information is provided on Part IV-Supplemental Information.)

EPA

EPA FORM R

PART III. CHEMICAL-SPECIFIC INFORMATION (continued)

(This space for your optional use.)

6. TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)	A. Total Transfers (pounds/yr)		B. Basis of Estimate	C. Type of Treatment/ Disposal
	A.1 Reporting Ranges 1-10 / 11-499 / 500-999	A.2 Enter Estimate	(enter code)	(enter code)
6.1.1 Discharge to POTW (enter location number from Part II, Section 1.) 1 .	[ ] [ ] [ ]		6.1.1b	
6.2.1 Other off-site location (enter location number from Part II, Section 2.) 2 .	[ ] [ ] [ ]		6.2.1b	6.2.1c M
6.2.2 Other off-site location (enter location number from Part II, Section 2.) 2 .	[ ] [ ] [ ]		6.2.2b	6.2.2c M
6.2.3 Other off-site location (enter location number from Part II, Section 2.) 2 .	[ ] [ ] [ ]		6.2.3b	6.2.3c M

[ ] (Check if additional information is provided on Part IV-Supplemental Information.)

7. WASTE TREATMENT METHODS AND EFFICIENCY

☐ Not Applicable (NA) - Check if no on-site treatment is applied to any waste stream containing the chemical or chemical catagory

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes / No
7.1a	7.1b	7.1c	7.1d [ ]	7.1e %	7.1f [ ] [ ]
7.2a	7.2b	7.2c	7.2d [ ]	7.2e %	7.2f [ ] [ ]
7.3a	7.3b	7.3c	7.3d [ ]	7.3e %	7.3f [ ] [ ]
7.4a	7.4b	7.4c	7.4d [ ]	7.4e %	7.4f [ ] [ ]
7.5a	7.5b	7.5c	7.5d [ ]	7.5e %	7.5f [ ] [ ]
7.6a	7.6b	7.6c	7.6d [ ]	7.6e %	7.6f [ ] [ ]
7.7a	7.7b	7.7c	7.7d [ ]	7.7e %	7.7f [ ] [ ]
7.8a	7.8b	7.8c	7.8d [ ]	7.8e %	7.8f [ ] [ ]
7.9a	7.9b	7.9c	7.9d [ ]	7.9e %	7.9f [ ] [ ]
7.10a	7.10b	7.10c	7.10d [ ]	7.10e %	7.10f [ ] [ ]

[ ] (Check if additional information is provided on Part IV-Supplemental Information.)

8. POLLUTION PREVENTION: OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of Modification (enter code)	B. Quantity of the Chemical in Wastes Prior to Treatment or Disposal			C. Index	D. Reason for Action (enter code)
	Current reporting year (pounds/year)	Prior year (pounds/year)	Or percent change (Check (+) or (-))		
M	_____	_____	☐ + ☐ - _____ %	.	R

(Important: Type or print; read instructions before completing form.)

EPA

EPA FORM R
PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Part III. Number the lines used sequentially from lines in prior sections (e.g., 5.3.4, 6.1.2, 7.11)

(This space for your optional use.)

ADDITIONAL INFORMATION ON RELEASES OF THE CHEMICAL TO THE ENVIRONMENT ON-SITE (Part III, Section 5.3)

You may report releases of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)		A. Total Release (pounds/yr) A.1 Reporting Ranges 1-10 11-499 500-999	A. Total Release (pounds/yr) A.2 Enter Estimate	B. Basis of Estimate (enter code in box provided)	C.% From Stormwater
5.3 Discharges to receiving streams or water bodies 5.3.___ [ ]	5.3.___a	[ ] [ ] [ ]		5.3.___b [ ]	5.3.___c %
(Enter letter code from Part I Section 3.10 for stream(s) in the box provided.) 5.3.___ [ ]	5.3.___a	[ ] [ ] [ ]		5.3.___b [ ]	5.3.___c %
5.3.___ [ ]	5.3.___a	[ ] [ ] [ ]		5.3.___b [ ]	5.3.___c %

ADDITIONAL INFORMATION ON TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS (Part III, Section 6)

You may report transfers of less than 1,000 pounds by checking ranges under A.1. (Do not use both A.1 and A.2)	A. Total Transfers (pounds/yr) A.1 Reporting Ranges 1-10 11-499 500-999	A. Total Transfers (pounds/yr) A.2 Enter Estimate	B. Basis of Estimate (enter code in box provided)	C. Type of Treatment/ Disposal (enter code in box provided)
6.1.___ Discharge to POTW (enter location number from Part II, Section 1.) 1.[ ]	[ ] [ ] [ ]		6.1.___b [ ]	
6.2.___ Other off-site location (enter location number from Part II, Section 2.) 2.[ ]	[ ] [ ] [ ]		6.2.___b [ ]	6.2.___c M[ ][ ]
6.2.___ Other off-site location (enter location number from Part II, Section 2.) 2.[ ]	[ ] [ ] [ ]		6.2.___b [ ]	6.2.___c M[ ][ ]
6.2.___ Other off-site location (enter location number from Part II, Section 2.) 2.[ ]	[ ] [ ] [ ]		6.2.___b [ ]	6.2.___c M[ ][ ]

ADDITIONAL INFORMATION ON WASTE TREATMENT METHODS AND EFFICIENCY (Part III, Section 7)

A. General Wastestream (enter code in box provided)	B. Treatment Method (enter code in box provided)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes No
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]
7.___a [ ]	7.___b [ ][ ][ ]	7.___c [ ]	7.___d [ ]	7.___e %	7.___f [ ] [ ]