This chapter details EPA's step-wise methodology for both defining the universe of mineral processing sectors, facilities, and waste streams potentially affected by the proposed Phase IV Land Disposal Restrictions and estimating the volumes of wastes potentially affected under the various implementation options being considered by the Agency. EPA presents the methodologies for determining the ranges in both the costs and benefits associated with compliance with the various implementation options being considered by the Agency in Chapters 4 and 5, respectively.

The Agency developed a step-wise methodology that began with the broadest possible scope of inquiry in order to assure that EPA captured all of the potentially affected mineral commodity sectors and waste streams. The Agency then narrowed the focus of its data gathering and analysis at each subsequent step. The specific steps and sources of data employed throughout this analysis are described below, and are summarized in Exhibit 3-1.

EXHIBIT 3-1

Overview of the Agency's Methodology for Defining the Universe of Potentially Affected Mineral Processing Waste Streams

Graphic Not Available.

CUT IN EXHIBIT 3-1

3.1 Identify Mineral Commodity Sectors of Interest

EPA reviewed the 36 industrial sectors (commodities) and 97 different general categories of wastes previously developed under this contract and published in the October 21, 1991 Advanced Notice of Proposed Rule Making (ANPRM). EPA also reviewed the U.S. Bureau of Mines's 1991 Minerals Yearbook, 1995 Mineral Commodities Summary, and the 1985 Mineral Facts and Problems. The Agency reviewed this comprehensive listing of all of the mineral commodity sectors and removed from further consideration all non-domestically produced mineral commodities; all inactive mineral commodities, such as nickel; and all mineral commodities generated from operations known not to employ operations that meet the Agency's definition of mineral processing.[1] As a result of this process, EPA identified a total of 62 mineral commodities that potentially generate “mineral processing” waste streams of interest. These mineral commodity sectors are listed below in Exhibit 3-2.

The Agency notes that Exhibit 3-2 represents EPA's best efforts at identifying mineral commodities which may generate mineral processing wastes. Omission or inclusion on this list does not relieve the generator from managing wastes that would be subject to RCRA Subtitle C requirements.

3.2 Conduct Exhaustive Information Search on Mineral Commodity Sectors of Interest

EPA researched and obtained information characterizing the mineral processing operations and wastes associated with the mineral commodities listed in Exhibit 3-2. This information was used by EPA both to update existing data characterizing mineral processing wastes obtained through past Agency efforts and to obtain characterization information on newly identified waste streams not previously researched.

To provide the necessary foundation to develop a fully comprehensive inventory of mineral commodity sectors, facilities, and waste streams that might be affected by the Phase IV LDRs program, EPA embarked on an ambitious information collection program. Specifically, to

[1] Sectors that employ operations that mill (e.g., grind, sort, wash), physically separate (e.g., magnetic, gravity, or electrostatic separation, froth flotation), concentrate using liquid separation (e.g., leaching followed by ion exchange), and/or calcine (i.e., heat to drive off water or carbon dioxide), and use no techniques that the Agency considers to be mineral processing operations (e.g., smelting or acid digestion) are unaffected by the proposed Phase IV LDRs.

EXHIBIT 3-2

MINERAL COMMODITIES OF POTENTIAL INTEREST

1) Alumina
2) Aluminum
3) Ammonium Molybdate
4) Antimony
5) Arsenic Acid
6) Asphalt (natural)
7) Beryllium
8) Bismuth
9) Boron
10) Bromine (from brines)
11) Cadmium
12) Calcium Metal
13) Cerium, Lanthanides, and Rare Earths
14) Cesium/Rubidium
15) Chromium
16) Coal Gas
17) Copper
18) Elemental Phosphorus
19) Ferrochrome
20) Ferrochrome-Silicon
21) Ferrocolumbium
22) Ferromanganese
23) Ferromolybdenum
24) Ferrosilicon
25) Gemstones
26) Germanium
27) Gold and Silver
28) Hydrofluoric Acid
29) Iodine (from brines)
30) Iron and Steel
31) Lead
32) Lightweight Aggregate
33) Lithium (from ores)
34) Lithium Carbonate
35) Magnesia (from brines)
36) Magnesium
37) Manganese and MnO_2
38) Mercury
39) Mineral Waxes
40) Molybdenum
41) Phosphoric Acid
42) Platinum Group Metals
43) Pyrobitumens
44) Rhenium
45) Scandium
46) Selenium
47) Silicomanganese
48) Silicon
49) Soda Ash
50) Sodium Sulfate
51) Strontium
52) Sulfur
53) Synthetic Rutile
54) Tantalum/Columbium
55) Tellurium
56) Tin
57) Titanium/TiO_2
58) Tungsten
59) Uranium
60) Vanadium
61) Zinc
62) Zirconium/Hafnium

capitalize on information collected through past efforts, as well as to collect more recent data, the Agency conducted the following activities:

- Reviewed the National Survey of Solid Wastes From Mineral Processing Facilities (NSSWMPF) survey instruments and public comments (submitted in response to the 1991 ANPRM) for process-related information (e.g., process flow diagrams, waste characterization data, and waste management information) contained in our in-house files.

- Reviewed numerous documents provided by EPA (e.g., Bureau of Mines publications, the Randol Mining Directory and other Industrial Directories, and various Agency contractor reports) for process-related information.

- Reviewed trip reports prepared both by EPA and its contractors from sampling visits and/or inspections conducted at approximately 50 mineral processing sites located through out the United States.

- Reviewed sampling data collected by EPA's Office of Research and Development (ORD), EPA's Office of Water (OW), and Agency survey data collected to support the preparation of the 1990 Report to Congress.

- Reviewed both the 1993, 1994, and 1995 “Mineral Commodity Summaries” prepared by the U.S. Bureau of Mines (BOM) for salient statistics on commodity production.

- Partially reviewed and summarized damage case information presented in the “Mining Sites on the National Priorities List, NPL Site Summary Reports” to support work on assessing the appropriateness of the Toxicity Characteristic Leaching Procedure (TCLP) for mineral processing wastes.

- Contacted the BOM Commodity Specialists associated with the commodity sectors of interest to (1) obtain current information on mining companies, processes, and waste streams, and (2) identify other potential sources of information.

- Retrieved applicable and relevant documents from the BOM's FAXBACK document retrieval system. Documents retrieved included monthly updates to salient statistics, bulletins, and technology review papers.

- Conducted an electronic query of the 1991 Biennial Reporting System (BRS) for waste generation and management information on 34 mineral processing-related Standard Industrial Classification (SIC) numbers.

- Conducted an electronic literature search for information related to mineral processing and waste treatment technologies contained in numerous technical on-line databases, including: NTIS, Compendex Plus, METADEX, Aluminum Industry Abstracts, ENVIROLINE, Pollution Abstracts, Environmental Bibliography, and GEOREF.

EPA focused its search for relevant information (published since 1990) on the mineral commodities listed in Exhibit 3-2. The Agency chose 1990 as the cutoff year so as not to duplicate past information collection activities conducted by EPA and its contractors, and to obtain information on mineral processes “retooled” since clarification of the Bevill Amendment to cover truly “high volume, low hazard” wastes. After an exhaustive search through both the publicly available and Agency-held information sources, EPA assembled and organized all of the collected information by mineral commodity sector.

3.3 Prepare Mineral Commodity Analysis Reports on Each of the Identified Sectors

As discussed above, EPA embarked on a very ambitious information collection program to collect current information on relevant mineral processes, salient statistics, waste characteristics, waste generation rates, and waste management information. All of the publicly available information was collected, evaluated for relevance (both applicability and age), and compiled to prepare 49 analyses covering 62 mineral commodities. Each mineral commodity analysis report consists of:

- A commodity summary describing the uses and salient statistics of the particular mineral commodity.
- A process description section with detailed, current process information and process flow diagram(s).
- A process waste stream section that identifies -- to the maximum extent practicable -- individual waste streams, sorted by the nature of the operation (i.e., extraction/beneficiation or mineral processing).[2] Within this section, EPA also identified:
  - waste stream sources and form (i.e., wastewater (<1 percent solids and total organic content), 1-10 percent solids, and >10% solids);
  - Bevill-Exclusion status of the waste stream (i.e., extraction/beneficiation waste stream, mineral processing waste stream, or non-uniquely associated waste stream).
  - waste stream characteristics (total constituent concentration data, and statements on whether the waste stream exhibited one of the RCRA hazardous waste characteristics of toxicity, ignitability, corrosivity, or reactivity);
  - annual generation rates (reported or estimated);
  - management practices (e.g., tank treatment and subsequent NPDES discharge, land disposal, or in-process recycling); and
  - whether the waste stream was being (or could potentially be) recycled, and be classified as either as a sludge, by-product, or spent material.

The collection and documentation of the commodity summary and process description sections of the mineral commodity analysis reports was relatively straight-forward and involved little interpretation on the part of EPA. However, the preparation of the process waste stream sections of the mineral commodity analysis reports required extensive analysis and substantive interpretation of the publicly available information by the Agency. The process used by EPA to develop descriptions of waste stream sources, form, characteristics, management, and recyclability is described below.

Waste Stream Sources and Form

EPA reviewed process descriptions and process flow diagrams obtained from numerous sources including, Kirk-Othmer, EPA's Effluent Guideline Documents, EPA survey instruments, and the literature. As one would expect, the available process descriptions and process flow diagrams varied considerably in both quality and detail, both by commodity and source of information. Therefore, EPA often needed to interpret the information to identify specific waste streams. For example, process descriptions and process flow charts found through the Agency's electronic literature search process often focused on the production process of the mineral product and omitted any description or identification of waste streams (including their point of generation). In such cases, the Agency used professional judgment to determine how and where wastes were generated.

[2] EPA strongly cautions that the process information and identified waste streams presented in the commodity analysis reports should not be construed to be the authoritative list of processes and waste streams. These reports represent a best effort, and clearly do not include every potential process and waste stream. Furthermore, the omission of an actual waste stream (and thus its not being classified as either an extraction/beneficiation or mineral processing waste in this report) does not relieve the generator from its responsibility of correctly determining whether the particular waste is covered by the Mining Waste Exclusion.

Bevill-Exclusion Status

EPA used the Agency's established definitions and techniques for determining which operations and waste streams might be subject to LDR standards. EPA decisions concerning whether individual wastes are within the scope of the RCRA Mining Waste Exclusion were based upon a number of different factors. The Agency examined these factors in sequence, in such a way as to yield unambiguous and consistent decisions from sector to sector. The step-wise methodology used for this analysis is presented below and summarized in Exhibit 3-3:

- Ascertain whether the material is considered a solid waste under RCRA.
- Determine whether the waste is generated by a primary mineral production step, and, more generally, whether or not primary production occurs in the sector/within a process type.
- Establish whether the waste and the operation that generates it are uniquely associated with mineral production.
- Determine whether the waste is generated by a mineral extraction, beneficiation, or processing step.
- Check to see whether the waste, if a processing waste, is one of the 20 special wastes from mineral processing.

This analytical sequence results in one of three outcomes:

(1) the material is not a solid waste and hence, not subject to RCRA;

(2) the material is a solid waste but is exempt from RCRA Subtitle C because of the Mining Waste Exclusion; or

(3) the material is a solid waste that is not exempt from RCRA Subtitle C and is subject to regulation as a hazardous waste if it is listed as a hazardous waste or it exhibits any of the characteristics of hazardous waste.[3]

Waste Stream Characteristics

EPA used waste stream characterization data obtained from numerous sources to document whether a particular waste stream exhibited one (or more) of the characteristics of a RCRA hazardous waste (i.e., toxicity, corrosivity, ignitability, and reactivity). In cases where actual data indicated that a waste did exhibit one of the characteristics of a hazardous waste, the specific characteristic(s) was designated with a **Y**. However, despite more than ten years of Agency research on mineral processing operations, EPA was unable to find waste characterization

[3] RCRA Subtitle C regulations define toxicity as one of the four characteristics of a hazardous waste. EPA uses the Toxicity Characteristic Leaching Procedure (TCLP) to assess whether a solid waste is a hazardous waste due to toxicity. The TCLP as applied to mineral processing wastes was recently remanded to the agency, for further discussion, see the Applicability of TCLP Technical Background Document elsewhere in today's docket.

EXHIBIT 3-3

PROCESS SUMMARY FOR EXCLUSION DETERMINATIONS

Graphic Not Available.

data for many waste streams. To present mineral commodity profiles that were as complete as possible, EPA used a step-wise methodology for estimating waste characteristics for individual waste streams when documented waste generation rates and analytical data were not available. Specifically, due to the paucity of waste characterization data (particularly, TCLP data), EPA used total constituent data (if available) or professional judgment to determine whether a particular waste exhibited one of the characteristics of a RCRA hazardous waste (i.e., toxicity, corrosivity, ignitability, and reactivity).

To determine whether a waste might exhibit the characteristic of toxicity, EPA first compared 1/20th of the total constituent concentration of each TC metal to its respective TC level.[4] In cases where total constituent data were not available, EPA then used professional judgment to evaluate whether the waste stream could potentially exhibit the toxicity characteristic for any of the TC metals. For example, if a particular waste stream resulted through the leaching of a desired metal from an incoming concentrated feed, the Agency assumed that the precipitated leach stream contained high total constituent (and therefore, high leachable) concentrations of non-desirable metals, such as arsenic. Continuing through the step-wise methodology, EPA relied on professional judgment to determine, based on its understanding of the nature of a particular processing step that generated the waste in question, whether the waste could possibly exhibit one (or more) of the characteristics of ignitability, corrosivity, or reactivity. Waste streams that EPA determined could potentially exhibit one or more of the characteristics of a RCRA hazardous waste were designated by **Y?**. The Agency acknowledges the inherent limitations of this conservative, step-wise methodology and notes that it is possible that EPA may have incorrectly assumed that a particular waste does (or does not) exhibit one or more of the RCRA hazardous waste characteristics.

The Agency stresses that the results and information presented in the individual commodity analysis reports are based on the review of publicly available information. The accuracy and representativeness of the collected information are only as good as the source documents. As a result of this limited data quality review, EPA notes that in some instances, Extraction Procedure (EP) leachate data reported by various sources are greater than 1/20th of the total constituent concentration. Generally one would expect, based on the design of the EP testing procedure, the total constituent concentrations to be at least 20-times the EP concentrations. This apparent discrepancy, however, can potentially be explained if the EP results were obtained from total constituent analyses of liquid wastes (i.e., EP tests conducted on wastes that contain less than one-half of one percent solids content are actually total constituent analyses).

Waste Stream Generation Rates

As data were available, EPA used actual waste generation rates reported by facilities in various Agency survey instruments and background documents. However, due to the general lack of data for many of the mineral commodity sectors and waste streams, the Agency needed to develop a step-wise method for estimating mineral processing waste stream generation rates when actual data were unavailable.

Specifically, EPA developed an "expected value" estimate for each waste generation rate using draft industry profiles, supporting information, process flow diagrams, and professional judgment. From the "expected value" estimate, EPA developed upper and lower bound estimates, which reflect the degree of uncertainty in our data and understanding of a particular sector, process, and/or waste in question. For example, EPA obtained average or typical commodity production rates from published sources (e.g., BOM Mineral Commodity Summaries) and determined input material quantities or concentration ratios from published market specifications. In parallel with this activity, EPA reviewed process flow diagrams for information on flow rates, waste-to-product ratios, or material quantities. The Agency then calculated any additional waste generation rates and subtracted out known material flows, leaving a defined material flow, which was allocated among the remaining unknown waste streams using professional judgment. Finally, EPA assigned a maximum, expected, and minimum volume estimate for each waste stream.

[4] Based on the assumption of a theoretical worst-case leaching of 100 percent and the design of the TCLP extraction test, where 100 grams of sample is diluted with two liters of extractant, the maximum possible TCLP concentration of any TC metal would be 1/20th of the total constituent concentration.

A key element in developing waste generation rates was the fact that by definition, average facility level generation rates of solids and sludges are less that 45,000 metric tons/year, and generation rates of wastewaters are less than 1,000,000 metric tons/year. Using this fact, in the absence of any supporting information, maximum values for solids and sludges were set at the highest waste generation rate found in the sector in question or 45,000 metric tons/year/ facility, whichever was lower.

The precise methodology for determining waste generation rates varied depending on the quantity and quality of available information. The waste streams for which EPA had no published annual generation rate were divided into five groups and a methodology for each group was assigned as follows.

1. **Actual generation rates for the waste in question from one or more facilities were available.** EPA extrapolated from the available data to the sector on the basis of waste-to-product ratios to develop the expected value, and used a value of +/- 20% of the expected value to define the upper and lower bounds.

2. **A typical waste-to-product ratio for the waste in question was available.** EPA multiplied the waste-to-product ratio by sector production (actual or estimated) to yield a sector wide waste generation expected value, and used one-half and twice this value for the lower and upper bounds, respectively.

3. **No data on the waste in question were available , but generation rates for other generally comparable wastes in the sector were.** EPA used the maximum and minimum waste generation rates as the upper and lower bounds, respectively, and defined the expected value as the midpoint between the two ends of the range. Adjustments were made using professional judgment if unreasonable estimates resulted from this approach.

4. **No data were available for any analogous waste streams in the sector, or information for the sector generally was very limited.** EPA drew from information on other sectors using analogous waste types and adjusting for differences in production rates/material throughput. The Agency used upper and lower bound estimates of one order of magnitude above and below the expected value derived using this approach. Results were modified using professional judgment if the results seemed unreasonable.

5. **All EPA knew (or suspected) was the name of the waste.** The Agency used the high value threshold (45,000 metric tons/year/facility or 1,000,000 metric tons/year/facility) as the maximum value, 0 or 100 metric tons per year as the minimum, and the midpoint as the expected value.

Waste Stream Management Practices

EPA reviewed process descriptions and process flow diagrams obtained from numerous sources including, Kirk-Othmer, EPA's Effluent Guideline Documents, EPA survey instruments, and the literature. As noted earlier, the available process descriptions and process flow diagrams varied considerably in both quality and detail, both by commodity and source of information. Therefore, EPA often needed to interpret the information to determine how specific waste streams were managed. For example, process descriptions and process flow charts found through the Agency's electronic literature search process often focused on the production process of the mineral product and omitted any description or identification of how or where waste streams were managed. In such cases, the Agency used professional judgment to determine how and where specific waste streams were managed. For example, EPA considered (1) how similar waste streams were managed at mineral processing facilities for which the Agency had management information, (2) the waste form and whether it was amenable to tank treatment, (3) generation rates, and (4) proximity of the point of waste generation to the incoming raw materials, intermediates, and finished products to predict the most likely waste management practice.

Waste Stream Recyclability and Classification

As was the case for the other types of waste stream-specific information discussed above, EPA was unable to locate published information showing that many of the identified mineral processing waste streams were being recycled. When information showing that a particular waste stream was being either fully or partially recycled was found, the recyclability of the waste stream was designated by **Y** and **YS**, respectively.

However, due to the paucity of data for many of the mineral commodity sectors and waste streams, the Agency needed to develop a method for determining whether a particular mineral processing waste stream was expected to be either fully or partially recycled, designated by **Y?** and **YS?**, respectively. The Agency developed a work sheet to assist EPA staff in making consistent determinations of whether the mineral processing waste streams could potentially be recycled, reused, or recovered. This work sheet, shown in Appendix A, was designed to capture the various types of information that could allow one, when using professional judgment, to determine whether a particular waste stream could be recycled or if it contained material of value.

If EPA determined that the waste stream was or could be fully/partially recycled, it used the definitions provided in 40 CFR §§ 260.10 and 261.1 to categorize the waste stream as either a by-product, sludge, or spent material. Appendix B presents the RCRA definitions and examples of by-products, sludges, and spent materials.

EPA, through the process of researching and preparing mineral commodity analysis reports for the mineral commodities listed in Exhibit 3-2, identified a total of 526 waste streams that are believed to be generated at facilities involved in mineral production operations. These extraction/beneficiation and mineral processing waste streams are listed in Appendix C.

3.4 Define the Universe of "Mineral Processing" Waste Streams Potentially Affected by the Phase IV LDRs

The Agency then evaluated each of the waste streams listed in Appendix C using the process outlined in Exhibit 3-4, to remove waste streams that would not be affected by the Phase IV LDRs. Specifically, EPA removed:

- All of the extraction and beneficiation waste streams;
- The "Special 20" Bevill-Exempt mineral processing waste streams;
- Waste streams that were known to be fully recycled in process; and
- All of the mineral processing waste streams that did not exhibit one or more of the RCRA characteristics of a hazardous waste (based on either actual analytical data or professional judgment).

As a result of this evaluation process, EPA narrowed the potential universe of waste streams that could potentially be affected by the proposed Phase IV LDRs to the 147 hazardous mineral processing waste streams presented below in Exhibit 3-5.[5]

[5] EPA strongly cautions that the list of waste streams presented in Exhibit 3-5 should not be construed to be the authoritative list of hazardous mineral processing waste streams. Exhibit 3-5 represents EPA's best effort, and clearly does not include every potential waste stream. Furthermore, the omission of an actual waste stream (and thus its not being classified as a hazardous mineral processing waste does not relieve the generator from its responsibility of correctly determining whether the particular waste is subject to Subtitle C requirements.

EXHIBIT 3-4

Graphic Not Available.

EXHIBIT 3-5

POTENTIALLY HAZARDOUS MINERAL PROCESSING WASTE STREAMS BY COMMODITY SECTOR

Alumina and Aluminum
- Cast house dust
- Electrolysis waste

Antimony
- Autoclave filtrate
- Slag and furnace residue

Beryllium
- Spent barren filtrate streams
- Bertrandite thickener slurry
- Beryl thickener slurry
- Chip treatment wastewater
- Filtration discard
- Spent raffinate

Bismuth
- Alloy residues
- Spent caustic soda
- Electrolytic slimes
- Lead and zinc chlorides
- Metal chloride residues
- Slag
- Spent electrolyte
- Spent soda solution
- Waste acid solutions
- Waste acids

Boron
- Waste liquor

Cadmium
- Caustic washwater
- Copper and lead sulfate filter cakes
- Copper removal filter cake
- Iron containing impurities
- Spent leach solution
- Lead sulfate waste
- Post-leach filter cake
- Spent purification solution
- Scrubber wastewater
- Spent electrolyte
- Zinc precipitates

Calcium
- Dust with quick lime

Coal Gas
- Multiple effects evaporator concentrate

Copper
- Acid plant blowdown
- Spent bleed electrolyte
- Waste contact cooling water
- Process wastewaters
- Scrubber blowdown
- Surface impoundment waste liquids
- Tankhouse slimes
- WWTP sludge

Elemental Phosphorus
- Dust
- AFM rinsate
- Furnace offgas solids
- Furnace scrubber blowdown
- Slag quenchwater

Fluorspar and Hydrofluoric Acid
- Off-spec fluosilicic acid

Germanium
- Waste acid wash and rinse water
- Chlorinator wet air pollution control sludge
- Hydrolysis filtrate
- Leach residues
- Spent acid/leachate
- Waste still liquor

Gold and Silver
- Refining wastes
- Slag
- Wastewater treatment sludge
- Wastewater

Lead
- Acid plant blowdown
- Acid plant sludge
- Baghouse incinerator ash
- Process wastewater
- Solid residues
- Spent furnace brick
- Stockpiled miscellaneous plant waste
- Surface impoundment waste liquids

Magnesium and Magnesia from Brines
- Cast house dust
- Smut

Mercury
- Dust
- Furnace residue
- Quench water

Molybdenum, Ferromolybdenum, and Ammonium Molybdate
- Flue dust/gases
- Liquid residues
- Molybdic oxide refining wastes

EXHIBIT 3-5 (Continued)

Platinum Group Metals
- Slag
- Spent acids
- Spent solvents

Pyrobitumens, Mineral Waxes, and Natural Asphalts
- Still bottoms
- Waste catalysts

Rare Earths
- Spent ammonium nitrate processing solution
- Spent iron/lead filter cake
- Lead backwash sludge
- Process wastewater
- Spent scrubber liquor
- Solvent extraction crud
- Waste solvent
- Wastewater from caustic wet APC
- Waste zinc contaminated with mercury

Rhenium
- Spent barren scrubber liquor
- Spent rhenium raffinate

Scandium
- Spent acids
- Spent solvents from solvent extraction

Selenium
- Spent filter cake
- Plant process wastewater
- Slag
- Tellurium slime wastes
- Waste solids

Synthetic Rutile
- Spent iron oxide slurry
- Spent acid solution

Tantalum, Columbium, and Ferrocolumbium
- Digester sludge
- Process wastewater
- Spent raffinate solids

Tellurium
- Slag
- Solid waste residues
- Waste electrolyte
- Wastewater

Titanium and Titanium Dioxide
- Pickle liquor and wash water
- Scrap milling scrubber water
- Scrap detergent wash water
- Smut from Mg recovery
- Leach liquor and sponge wash water
- Spent surface impoundment liquids
- Spent surface impoundments solids
- Waste acids (Chloride process)
- Waste acids (Sulfate process)
- WWTP sludge/solids

Tungsten
- Spent acid and rinse water
- Process wastewater

Uranium
- Waste nitric acid from UO2 production
- Vaporizer condensate
- Superheater condensate
- Uranium chips from ingot production

Zinc
- Acid plant blowdown
- Waste ferrosilicon
- Process wastewater
- Discarded refractory brick
- Spent cloths, bags, and filters
- Spent surface impoundment liquids
- Spent surface impoundment solids
- Spent synthetic gypsum
- TCA tower blowdown
- Wastewater treatment plant liquid effluent
- Zinc-lean slag

Zirconium and Hafnium
- Spent acid leachate from zirconium alloy production
- Spent acid leachate from zirconium metal production
- Leaching rinse water from zirconium alloy production
- Leaching rinse water from zirconium metal production

Note: EPA was unable to collect sufficient information to determine whether the production of Bromine, Gemstones, Iodine, Lithium and Lithium Carbonate, Soda Ash, Sodium Sulfate, and Strontium produce mineral processing wastes.

3.5 Define the Universe of "Mineral Processing" Facilities Potentially Affected by the Phase IV LDRs

EPA then used the information contained in the individual sector analysis reports to identify the number of facilities, by commodity, that potentially generated the hazardous mineral processing wastes listed in Exhibit 3-5. As discussed earlier, the individual sector analysis reports listed the facilities involved in the production of a particular mineral commodity. In addition, as the available information allowed, the Agency also (1) identified the specific processes used by each facility and (2) identified the specific waste streams generated by process. However, in cases where the Agency had insufficient information to determine which of the individual facilities generated a particular waste stream, EPA assumed that the waste stream was generated at all of the reported facilities known to be using the same process.

The Agency then used the individual sector analysis reports, various U.S. Bureau of Mines documents, the Randol Mining Directory, and the Mine Safety and Health Administration (MSHA) address/employment database to determine which of the mineral processing facilities were collocated with mining and/or extraction/beneficiation facilities.

Lastly, the Agency used the 1990 Report to Congress and the individual commodity sector analysis reports to identify the mineral processing facilities that also generate one (or more) of the special 20 Bevill-Exempt mineral processing wastes.

Appendix D presents a summary of the mineral processing facilities by mineral commodity sector that generate hazardous mineral processing wastes. Appendix D also indicates whether the mineral processing facilities are collocated and/or generate one (or more) of the "Special 20" waste streams. Appendix E, presents the same information (as shown in Appendix D) for the mineral processing sectors that do not generate hazardous mineral processing wastes.

3.6 Prepare Final Estimates of the Volume of Mineral Processing Waste Streams Potentially Affected by the Phase IV LDRs

To account for the uncertainty in the data caused by the lack of published information on both waste characteristics and recyclability, EPA developed a range of minimum, expected, and maximum estimates of waste volumes potentially affected by the various options. Specifically, EPA weighted the volume estimates for each waste stream to account for the degree of certainty in whether the particular waste stream exhibited one or more of the RCRA hazardous waste characteristics and/or is recycled. As shown below in Exhibits 3-6 and 3-7, EPA constructed two

EXHIBIT 3-6
PORTION OF WASTE STREAM CONSIDERED TO BE HAZARDOUS IN SECTOR-WIDE TOTALS (PERCENT)

	Hazard Characteristic(s)	
Costing Scenario	**Y**	**Y?**
Minimum	100	0
Expected	100	50
Maximum	100	100

where:

Y means that EPA has actual analytical data demonstrating that the waste exhibits one or more of the RCRA hazardous characteristics.

Y? means that EPA, based on professional judgment, believes that the waste may exhibit one or more of the RCRA hazardous characteristics.

EXHIBIT 3-7
PORTION OF WASTE STREAM CONSIDERED TO NOT BE RECYCLED IN SECTOR-WIDE TOTALS (PERCENT)

	Percentage of Waste Quantity Assumed to Be Treated/Disposed			
Costing Scenario	**Y**	**Y?**	**YS**	**YS?**
Minimum	0	0	20	20
Expected	0	0	50	50
Maximum	20	50	80	80

where:

Y means that EPA has information indicating that the waste stream is fully recycled.

Y? means that EPA, based on professional judgment, believes that the waste stream could be fully recycled.

YS means that EPA has information indicating that a portion of the waste stream is fully recycled.

YS? means that EPA, based on professional judgment, believes that a portion of the waste stream could be fully recycled.

matrices, one to account for the uncertainty in waste characterization and the other to account for the uncertainty in the degree to which a waste is (or may be) recycled.

EPA systematically multiplied the percentages presented in the two matrices to each waste stream to develop final estimates of the minimum, expected, and maximum annual generation rates of each waste stream within each mineral commodity sector. For example, if a waste stream was suspected to be hazardous and is known to be partially recycled:

- In the minimum cost case, none of the waste would be included in the sector total waste generation rate (i.e., 0 percent times 20 percent times the minimum generation rate = 0 percent).

- In the expected cost case, 25 percent of the waste would be included in the sector total waste generation rate (i.e., 50 percent times 50 percent times the expected generation rate = 25 percent).

- In the maximum cost case, 80 percent of the waste would be included in the sector total waste generation rate (i.e., 80 percent times 100 percent times the maximum generation rate).

EPA then totalled each of the estimated waste stream generation rates by costing scenario (i.e., minimum, expected, and maximum) to arrive at total waste generation rates by mineral commodity sector. Exhibit 3-8 presents the final mineral processing waste stream database used in the baseline analyses conducted in both the cost and benefit analyses discussed in Chapters 4 and 5, respectively. (See Chapters 4 and 5 for a description of how EPA used the data presented in Exhibit 3-8 as a starting point for both the cost and benefits analyses, respectively.) Lastly, Exhibit 3-9 presents tabular summaries of the number of facilities, number of waste streams, and waste stream volumes computed for each mineral commodity sector and waste form used in the baseline analysis.

As shown below in Exhibit 3-9, the total volume of hazardous mineral processing waste streams being recycled is 27,279,000 metric tons/yr (or 63 percent of the total volume of hazardous mineral processing waste streams). The volume of hazardous mineral processing waste streams considered in both options as being treated and disposed is 10,390,000 metric tons/yr.

EXHIBIT 3-8

FINAL MINERAL PROCESSING WASTE STREAM DATABASE - BASELINE ANALYSIS

Graphic Not Available.

EXHIBIT 3-9

OPTION 1 - EXPECTED CASE

Waste Form:	Total				Wastewater				1 - 10 Percent Solids Content				>10 Percent Solids Content			
	Number of Sectors	Number of Waste Streams	Number of Facilities	Quantity of Waste (mt/yr)	Number of Sectors	Number of Waste Streams	Number of Facilities	Quantity of Waste (mt/yr)	Number of Sectors	Number of Waste Streams	Number of Facilities	Quantity of Waste (mt/yr)	Number of Sectors	Number of Waste Streams	Number of Facilities	Quantity of Waste (mt/yr)
Universe of MP Waste Streams	62	354	368	83,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potentially Hazardous MP Waste Streams	31	148	186	43,131,000	25	58	137	27,352,000	8	16	22	12,191,000	25	74	162	3,588,000
Recycled Hazardous MP Waste Streams Stored on Land	29	97	NA	27,279,000	21	41	NA	17,691,000	6	10	NA	8,415,000	20	46	NA	1,173,000
Hazardous MP Waste Treated and Disposed	26	87	NA	10,390,000	18	36	NA	5,739,000	5	10	NA	3,480,000	19	41	NA	1,171,000

Notes: All values estimated using available data and professional judgment.

The number of waste streams and sectors are not additive as some waste streams are partially recycled.

In the expected value case, only half the quantity of waste streams suspected to be hazardous is sent to recycling or treatment and disposal. The remainder is considered non-hazardous and drops out of the analysis. Therefore, the sum of recycled and treated/disposed materials will not equal the quantity of potentially hazardous mineral processing waste streams.