EPA/310-R-00-001

EPA Office of Compliance Sector Notebook Project

Profile of the Agricultural Crop Production Industry

September 2000

U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

GENERAL INFORMATION

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by GeoLogics Corporation (Alexandria, VA), Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

Obtaining copies:

Electronic versions of all sector notebooks are available via Internet on the Enviroene World Wide Web at **www.epa.gov/oeca/sector**. Enviroene is a free, public, environmental exchange system operated by EPA's Office of Enforcement and Compliance Assurance and Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization. Direct technical questions to the "Feedback" button on the bottom of the web page.

Purchase printed bound copies from the **Government Printing Office (GPO)** by consulting the order form at the back of this document or order via the Internet by visiting the on-line GPO Sales Product Catalog at **http://orders.access.gpo.gov/su_docs/sale/prf/prf.html**. Search using the exact title of the document "Profile of the XXXX Industry" or simply "Sector Notebook." When ordering, use the GPO document number found on the order form at the back of this document.

Complimentary volumes are available to certain groups or subscribers, including public and academic libraries; federal, state, tribal, and local governments; and the media from EPA's National Service Center for Environmental Publications at **(800) 490-9198.** When ordering, use the EPA publication number found on the following page.

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460
(202) 564-7017

For further information, and for answers to questions pertaining to these documents, please refer to the contact names listed on the following page.

SECTOR NOTEBOOK CONTACTS

Questions and comments regarding the individual documents should be directed to the specialists listed below. **See the Notebook web page at: *www.epa.gov/oeca/sector* for the most recent titles and staff contacts.**

EPA Publication Number	Industry	Contact	Phone
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry	Joyce Chandler	202-564-7073
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*	Steve Hoover	202-564-7007
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry	Bob Marshall	202-564-7021
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*	Walter DeRieux	202-564-7067
EPA/310-R-95-005.	Profile of the Iron and Steel Industry	Maria Malave	202-564-7027
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry	Seth Heminway	202-564-7017
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*	Scott Throwe	202-564-7013
EPA/310-R-95-008.	Profile of the Metal Mining Industry	Maria Malave	202-564-5027
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry	Anthony Raia	202-564-6045
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry	Debbie Thomas	202-564-5041
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	202-564-2628
EPA/310-R-95-012.	Profile of the Organic Chemical Industry *	Walter DeRieux	202-564-7067
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry	Tom Ripp	202-564-7003
EPA/310-R-95-014.	Profile of the Printing Industry	Ginger Gotliffe	202-564-7072
EPA/310-R-95-015.	Profile of the Pulp and Paper Industry	Seth Heminway	202-564-7017
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry		202-564-2310
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	202-564-7013
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.	Virginia Lathrop	202-564-7057
EPA/310-R-97-001.	Profile of the Air Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-002.	Profile of the Ground Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-003.	Profile of the Water Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-004.	Profile of the Metal Casting Industry	Steve Hoover	202-564-7007
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry	Emily Chow	202-564-7071
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	202-564-7074
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	202-564-7028
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry	Anthony Raia	202-564-6045
EPA/310-R-97-009.	Profile of the Textile Industry		202-564-2310
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **	Seth Heminway	202-564-7017
EPA/310-R-98-001.	Profile of the Aerospace Industry	Anthony Raia	202-564-6045
EPA/310-R-99-006.	Profile of the Oil and Gas Extraction Industry	Dan Chadwick	202-564-7054
EPA/310-R-00-001.	Profile of the Agricultural Crop Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-002.	Profile of the Agricultural Livestock Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry	Michelle Yaras	202-564-4153
Government Series			
EPA/310-R-99-001.	Profile of Local Government Operations		202-564-2310

* Spanish translations available.

** This document revises compliance, enforcement, and toxic release inventory data for all profiles published in 1995.

Table of Contents

LIST OF EXHIBITS

LIST OF ACRONYMS

ACM	Asbestos-Containing Materials
AFO	Animal Feeding Operations
AFPA	American Forest Paper Association
AFS	AIRS Facility Subsystem (CAA database)
ANSI	American National Standards Institute
BIF	Boiler and Industrial Furnace
BLM	Bureau of Land Management
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
Bt	Bacillus thuringiensis
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CCAP	Climate Change Action Plan
CDA	Controlled Droplet Application
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	CERCLA Information System (CERCLA database)
CESQG	Conditionally Exempt Small Quantity Generator
CFC	Chlorofluorocarbon
CFO	Conservation Farm Option
CFR	Code of Federal Regulations
CNMP	Comprehensive Nutrient Management Plan
CPA	Conservation Priority Area
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CZARA	Coastal Zone Act Reauthorization Amendments
DOT	United States Department of Transportation
DOJ	United States Department of Justice
DUN	Dun and Bradstreet
EMS	Environmental Management Systems
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EQIP	Environmental Quality Incentives Program
ESPP	Endangered Species Protection Program
FDA	United States Food and Drug Administration
FFDCA	Federal Food, Drug and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FQPA	Food Quality Protection Act
FR	Federal Register

LIST OF ACRONYMS (CONTINUED)

FS	Forest Service
FSA	Farm Service Agency
FWS	Fish and Wildlife Service
FY	Fiscal Year
GPS	Global Positioning System
HAP	Hazardous Air Pollutant (CAA)
HSWA	Hazardous and Solid Waste Amendments
HUD	United States Department of Housing and Urban Development
IDEA	Integrated Data for Enforcement Analysis
IPM	Integrated Pest Management
ISO	International Organization for Standardization
LDR	Land Disposal Restrictions (RCRA)
LEPC	Local Emergency Planning Committee
LQG	Large Quantity Generator
MACT	Maximum Achievable Control Technology (CAA)
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards (CAA)
NAICS	North American Industrial Classification System
NASS	National Agricultural Statistics Service
NCBD	National Compliance Database, Office of Prevention, Pesticides and Toxic Substances
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NICE^3	National Industrial Competitiveness Through Energy, Environment, and Economics
NOA	Notice of Arrival
NPS	Nonpoint Source Management Program
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Agency
NPDES	National Pollutant Discharge Elimination System (CWA)
NPL	National Priorities List
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standards (CAA)
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PCS	Permit Compliance System

LIST OF ACRONYMS (CONTINUED)

PESP	Pesticide Environmental Stewardship Program
PMN	Premanufacture Notice
POTW	Publicly Owned Treatment Works
PWS	Public Water Systems
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System (RCRA database)
RMP	Risk Management Plan
RQ	Reportable Quantities
RUP	Restricted Use Pesticides
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEP	Supplemental Environmental Project
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SPCC	Spill Prevention, Control, and Countermeasure
SQG	Small Quantity Generator
TMDL	Total Maximum Daily Load
TRI	Toxic Release Inventory
TRIS	Toxics Release Inventory System
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
USDA	U.S. Department of Agriculture
UST	Underground Storage Tank (RCRA)
WHIP	Wildlife Habitat Incentives Program
WPS	Worker Protection Standard Requirements for Users
WRP	Wetlands Reserve Program

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are becoming an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies addressing all media for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial ?sector-based" approach by the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above alone could be the subject of a lengthy volume. However, to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be explored further based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process. The Office of

Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be sent via the web page.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the relative national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or repackage the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers also may want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks, please contact the Office of Compliance at 202-564-2310.

II. INTRODUCTION TO THE AGRICULTURAL PRODUCTION INDUSTRIES: CROPS, GREENHOUSES/NURSERIES, AND FORESTRY

This section provides background information on three types of agricultural production industries:

- Establishments that produce crops, including oilseed and grains, vegetables and melons, fruit and tree nuts, and other crops
- Greenhouses and nurseries
- Establishments engaged in forestry and logging.

This section defines these industries in terms of their North American Industrial Classification System (NAICS) codes. According to NAICS, establishments that produce crops and greenhouses/nurseries are classified in ***NAICS code 111 (Crop Production)***. Because greenhouses/nurseries comprise a large number of the entities in NAICS 111 and are somewhat different in actual practices, this notebook presents data and information on them separately from crop production. Greenhouse, nursery, and floriculture production is classified as ***NAICS code 1114.*** Establishments engaged in forestry are classified in ***NAICS code 113 (Forestry and Logging)***. The forestry production industry has practices that differ significantly from those used for crops and greenhouses/nurseries.

> The Office of Management and Budget (OMB) has replaced the Standard Industrial Classification (SIC) system, which was used to track the flow of goods and services within the economy, with the NAICS. The NAICS, which is based on similar production processes to the SIC system, is being implemented by OMB.

Establishments primarily engaged in crop production and forestry are classified in subgroup(s), up to six digits long, based on the total value of sales of agricultural products. An establishment would be placed in the group that represents 50 percent or more of its total sales. For example, if 51 percent of the total sales of an establishment is wheat, then it would be classified under NAICS codes 1111 (Oilseed and Grain Farming) and 11114 (Wheat Farming).

Data for the notebook, specifically in this chapter, were obtained from the U.S. Department of Agriculture (USDA) and the 1997 Agriculture Census (Ag Census). All data are the most recent publicly available data for the source cited.

II.A. General Overview of Agricultural Establishments

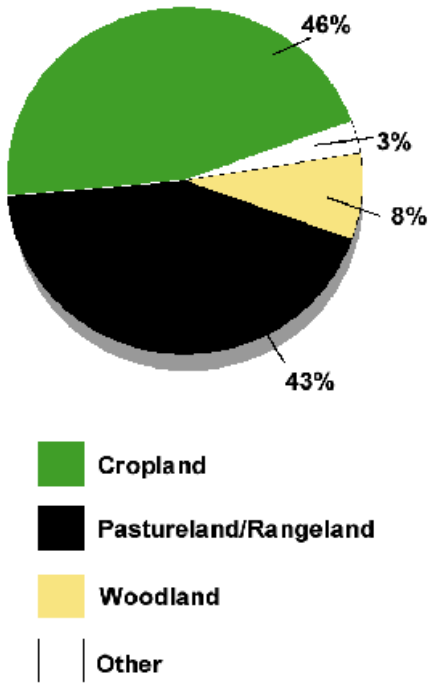
This section presents a general overview of agricultural establishments to provide background information regarding the number of such establishments

and production data. The USDA's National Agricultural Statistics Service (NASS) defines an *agricultural establishment* (i.e., farm) based on production. It defines a farm as a place which produced or sold, or normally would have produced or sold, $1,000 or more of agricultural products during the year. Agricultural products include all products grown by establishments described in this profile, which are classified under NAICS codes 111, 113, and 1114, as well as those in NAICS code 112 - Animal Production, which are covered in the *Profile of the Agricultural Livestock Production Industry*.

According to the 1997 Ag Census, there were more than 1.9 million farms (i.e., agricultural establishments) in the United States. Of these, approximately 47 percent (902,372 farms) were classified as NAICS code 111 - Crop Production. The other 53 percent (1,009,487 farms) were classified as NAICS code 112 - Animal Production. These 1.9 million agricultural establishments represent nearly 932 million acres of land, with the average agricultural establishment consisting of 487 acres. (Note: 1 acre is approximately the size of a football field.) Both of these numbers--932 million acres and 487 acres--are smaller than those for 1992, which were 946 million acres and 491 acres, respectively.

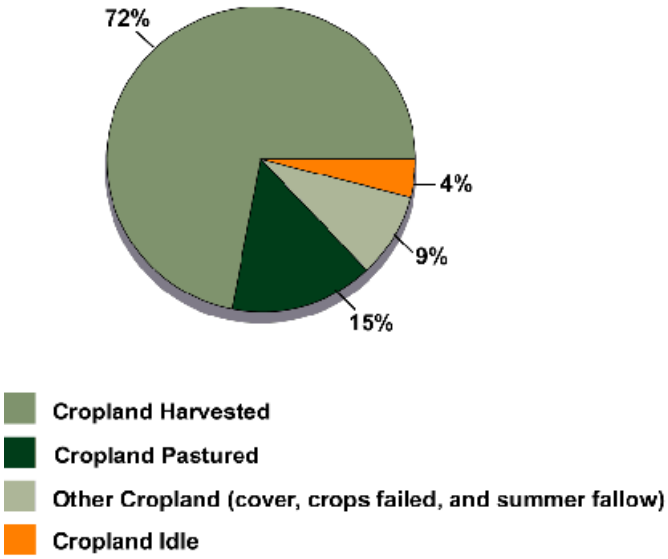
As shown in Exhibit 1, of the 932 million acres of agricultural land, the overwhelming majority (89%) consists of cropland and pastureland/rangeland.

Exhibit 1. Agricultural Land Use in the U.S. (1997 Ag Census)



As presented in Exhibit 2, the 1997 Ag Census describes cropland as:

Exhibit 2. Types of Cropland (1997 Ag Census)



- *Harvested cropland* -- Includes all acreage from which crops are harvested, such as: (1) corn, wheat, barley, oats, sorghum, soybeans, cotton, and tobacco; (2) wild or tame harvested hay, silage, and green chop; and (3) vegetables. It also includes land in orchards and vineyards; all acres in greenhouses, nurseries, Christmas trees, and sod; and any other acreage from which a crop is harvested even if the crop is considered a partial failure and the yield is very low.

- *Cropland used only for pasture or grazing* -- Includes land pastured or grazed which could be used for crops without any additional improvement, and land in planted crops that is pastured or grazed before reaching maturity.

- *Cropland used for cover crops* -- Includes land used only to grow cover crops for controlling erosion or to be plowed under for improving the soil.

- *Cropland on which all crops failed* -- Includes: (1) all land from which a crop failed (except fruit or nuts in an orchard, grove, or vineyard being maintained for production) and no other crop is harvested and which is not pastured or grazed, and (2) acreage not harvested due to low prices or labor shortages.

- *Cultivated summer fallow* -- Includes cropland left unseeded for harvest, and cultivated or treated with herbicides to control weeds and conserve moisture.

- *Idle cropland* -- Includes any other acreage which could be used for crops without any additional improvement and which is not included in one of the above categories of cropland.

The 1997 Ag Census describes pastureland and rangeland as land, other than cropland or woodland pasture, that is normally used for pasture or grazing. This land, sometimes called "meadow" or "prairie," may be composed of bunchgrass, shortgrass, buffalo grass, bluestem, bluegrass, switchgrass, desert shrubs, sagebrush, mesquite, greasewood, mountain browse, salt brush, cactus, juniper, and pinion. It also can be predominantly covered with brush or browse.

As shown in Exhibit 3, approximately 82 percent of agricultural establishments in 1997 consisted of fewer than 500 acres; only 4 percent consisted of 2,000 or more acres.

Exhibit 3. Acreage of Agricultural Establishments in the U.S. (1997 Ag Census)

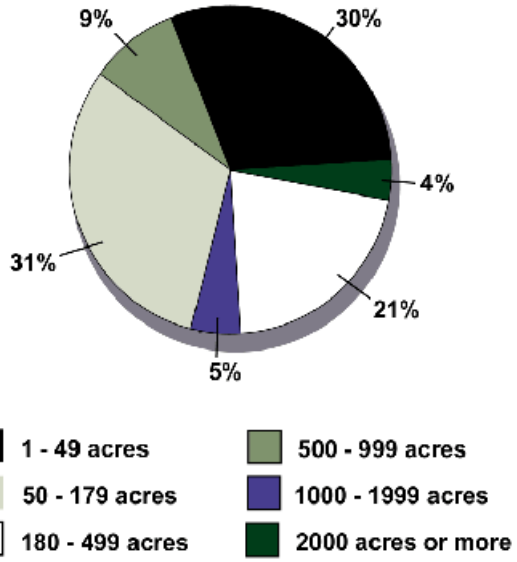
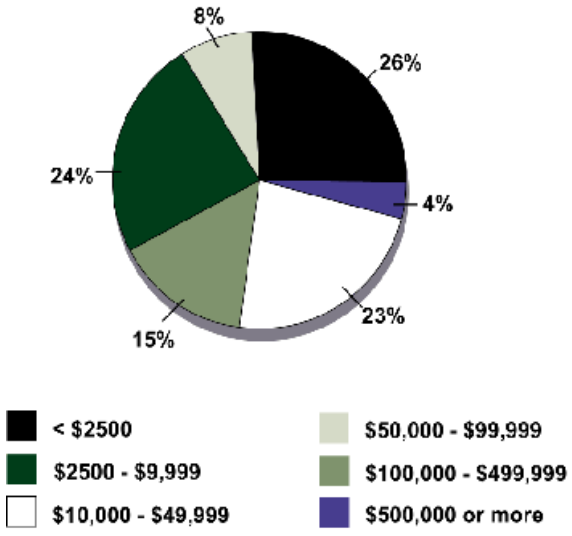


Exhibit 4. Agricultural Establishments by Value of Sales (1997 Ag Census)



According to the 1997 Ag Census, all agricultural establishments combined to produce approximately $197 billion worth of agricultural products.

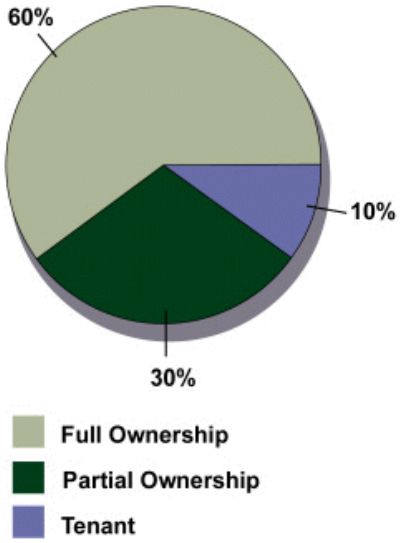
The market value of the agricultural products sold was split almost evenly between crop production, including nursery and greenhouse crops (49.6%) and livestock production (50.4%).

As shown in Exhibit 4, approximately 73 percent of all agricultural establishments produced less than $50,000 worth of agricultural products.

In addition to tracking the number of agricultural establishments and the value of products sold, the Ag Census tracks and identifies other characteristics of agricultural establishments, such as ownership and organization. Exhibit 5 presents a breakdown of the ownership status of agricultural establishments in the U.S. The Ag Census basically identifies the ownership status of agricultural establishments by one of three categories:

- Full ownership, in which full owners operate only the land they own.
- Partial ownership, in which partial owners operate land they own and also land they rent from others.
- Tenant/rental arrangement, in which tenants operate only land they rent from others or work on shares for others.

Exhibit 5. Ownership Status of Agricultural Establishments in the U.S.
(1997 Ag Census)



The Census further classifies agricultural establishment ownership by the person or entity who owns the establishment. There are four distinct types of organization: (1) individual or family (sole proprietorship); (2) partnership, including family partnership; (3) corporation, including family corporation, and (4) other, including cooperatives, estate or trust, and institutional. Approximately 86 percent of all establishments are owned and operated by individuals or families. Partnerships account for another 9 percent of the establishments and corporations own just more than 4 percent of the establishments. Fewer than 1 percent of all farms are owned by other organizations (1997 Ag Census).

II.B. Characterization of the Crop Production Industry

This section provides data and information on the crop production industry. For the purposes of this profile, crop production includes the four categories of commodities presented in Exhibit 6. This notebook follows the structure provided by the 1997 Ag Census, which classifies all of these commodity production operations within NAICS code 111. Because the notebook is addressing greenhouse, nursery, and floriculture products separately in the next section, they are not included within this discussion.

Exhibit 6. 1997 NAICS Descriptions for Crop Production (NAICS 111)

Type of Establishment	NAICS Code	SIC Code	Description
Oilseed and Grain	1111	0116, 0119	Establishments primarily engaged in: 1) growing oilseed and/or grain crops and/or 2) producing oilseed and grain seeds. These crops have an annual growth cycle and are typically grown in open fields.
Vegetables and Melons	1112	0134, 0139, 0161	Establishments primarily engaged in growing root and tuber crops (except sugar beets and peanuts) or edible plants and/or producing root and tuber or edible plant seeds. The crops included in this group have an annual growth cycle and are grown in open fields.
Fruits and Tree Nuts	1113	0171, 0172, 0173, 0174, 0175, 0179	Establishments primarily engaged in growing fruit and/or tree nut crops. The crops included in this industry group are generally not grown from seeds and have a perennial life cycle.
Other Crops	1119	0131, 0132, 0133, 0139, 0191, 0831, 2099	Establishments primarily engaged in: 1) growing crops (other than those listed previously), such as tobacco, cotton, sugarcane, hay, sugar beets, peanuts, agave, herbs and spices, and hay and grass seeds, or 2) growing a combination of these crops.

In 1997, there were 845,180 establishments producing the four categories of commodities referenced above. All these establishments combined covered nearly 400 million acres, of which more than half (236 million acres) was harvested cropland. The average crop producing establishment in 1997 was approximately 473 acres in size and averaged approximately 279 acres of harvested cropland. Of the 845,180 crop producing establishments, more than 50 percent (462,877) were classified as oilseed and grain farming (see Exhibit 7). Also, as shown in Exhibit 8, oilseed and grain farming accounted for the majority of the land in acres as well as harvested cropland.

Exhibit 7. Number of Farms
(1997 Ag Census)

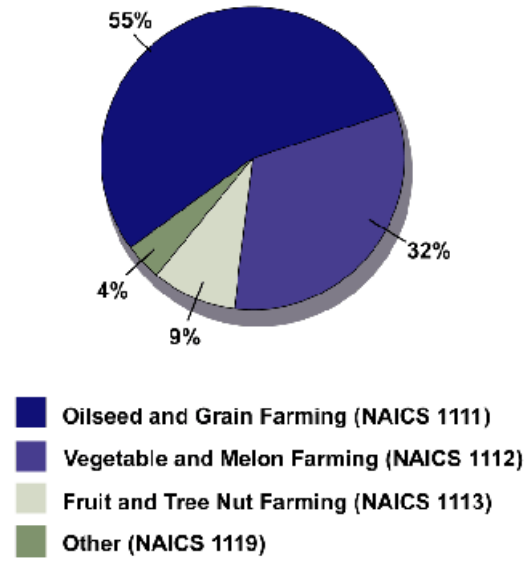


Exhibit 8. Land in Acres vs. Acres of Harvested Cropland (in millions of acres) (1997 Agriculture Census)

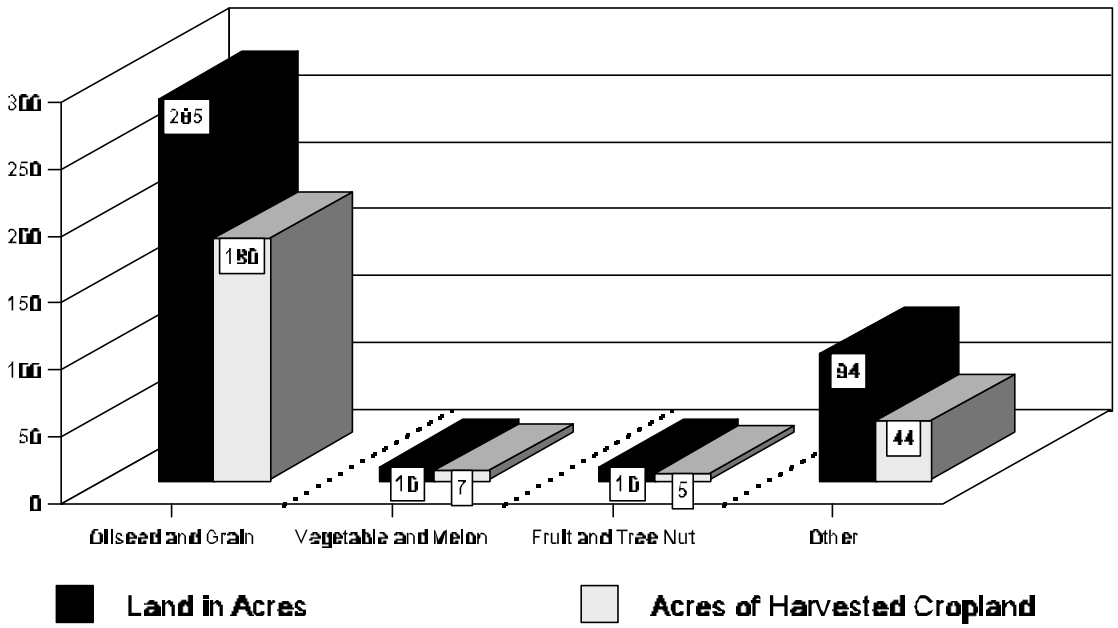
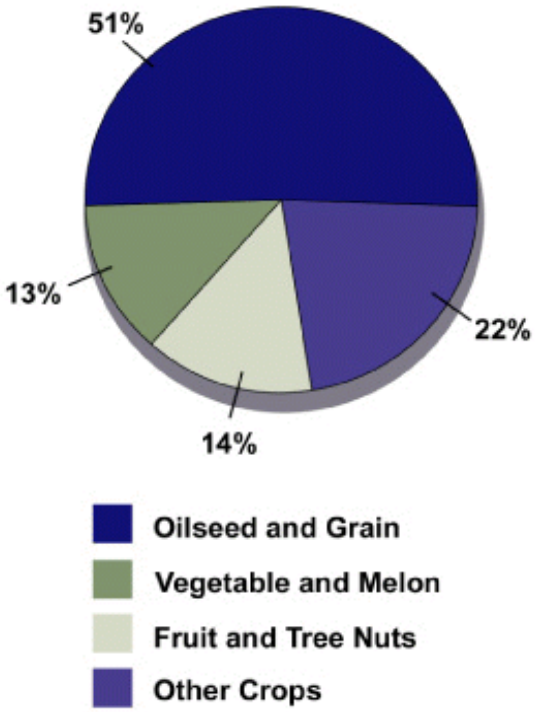


Exhibit 9. Percent of Sales by Type of Establishment (1997 Ag Census)



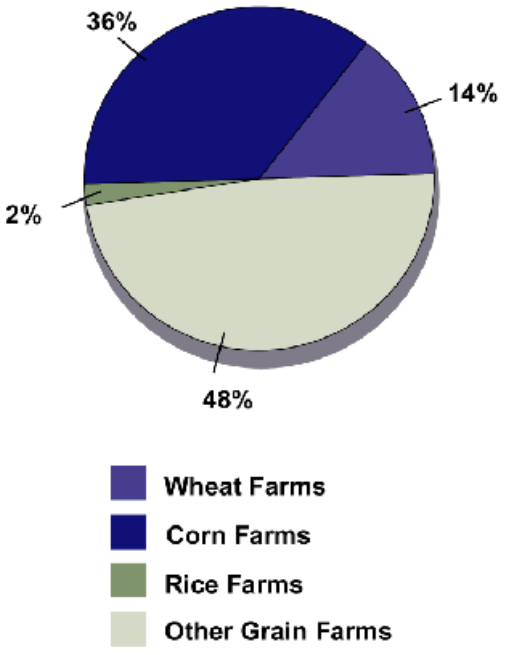
The four types of crop-producing establishments defined above accounted for approximately $87 billion worth of products sold in 1997. Exhibit 9 presents the distribution of those sales among the four types of establishments.

II.B.1. Oilseed and Grain

Oilseed and grain accounted for the majority of agricultural sales in the U.S. in 1997. For the purposes of the 1997 Ag Census, oilseed includes primarily soybeans, but also dry peas and beans, canola, flaxseeds, mustard seeds, oilseeds, rapeseeds, safflower, sesame seeds, and sunflowers. Grain includes wheat, corn, rice, and other grains such as barley, broomcorn, buckwheat, milo, oats, rye, sorghum, and wild rice. These grains are considered both food and feed grains, meaning they may be used either in food production or as feed for livestock.

In 1997, there were 462,877 oilseed and grain establishments in the U.S.; 94,481 were oilseed establishments and 368,396 were grain establishments. As shown in Exhibit 10, corn-producing establishments comprise the majority of the grain establishments in the U.S. On average, each grain-producing establishment is approximately 671 acres. Of those, approximately 407 acres are harvested cropland.

Exhibit 10. Type of Grain Farms (1997 Ag Census)



II.B.2. Vegetables and Melons

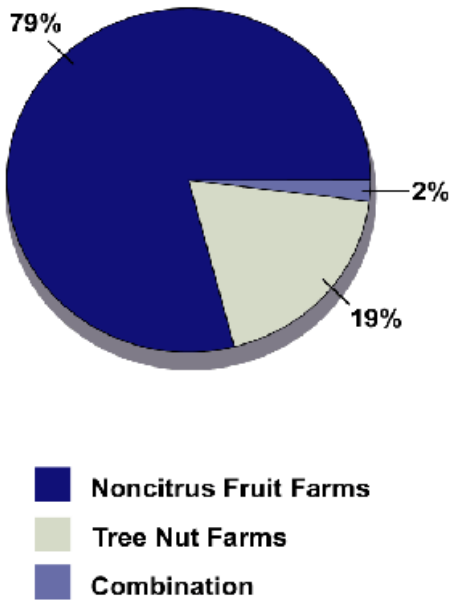
Vegetable and melon farming accounts for 31,030 establishments, or just less than 4 percent of the total crop-producing establishments in the U.S. An average vegetable and melon establishment consists of approximately 330 acres, of which approximately 170 acres are harvested cropland. Potato farming is the largest subgroup within vegetable and melon farming. It comprises nearly 12 percent of all vegetable and melon farms. The average potato-producing establishment has approximately 981 acres; approximately 730 of these acres are harvested cropland.

II.B.3. Fruit and Tree Nuts

Fruit and tree nut farming comprised the third largest group of crop-producing establishments combining for 81,956 establishments. This category is basically broken into two categories: 1) citrus fruits, and 2) noncitrus fruits and tree nuts. Citrus-producing establishments (i.e., groves) accounted for 12,275 establishments, or approximately 15 percent of all fruit and tree nut establishments. Noncitrus fruits and tree nuts, which include apples, grapes, strawberries, other berries, tree nuts, and other noncitrus fruits, comprised the remainder of the establishments (69,681) in 1997. (Tree nuts include almonds, hazelnuts, walnuts, macadamia nuts, pecans, and pistachios.) The percentages of noncitrus fruit and tree nut establishments are presented in Exhibit 11.

In 1997, the average fruit and tree nut establishment was 127 acres, with approximately half of those acres being harvested. Orange groves accounted for more than 75 percent of all citrus fruit establishments. Florida dominates citrus fruit production, except for lemons. Noncitrus fruits are grown across the country. Tree nuts are grown primarily in California and Hawaii.

Exhibit 11. Noncitrus Fruit and Tree Nut Farms
(1997 Ag Census)

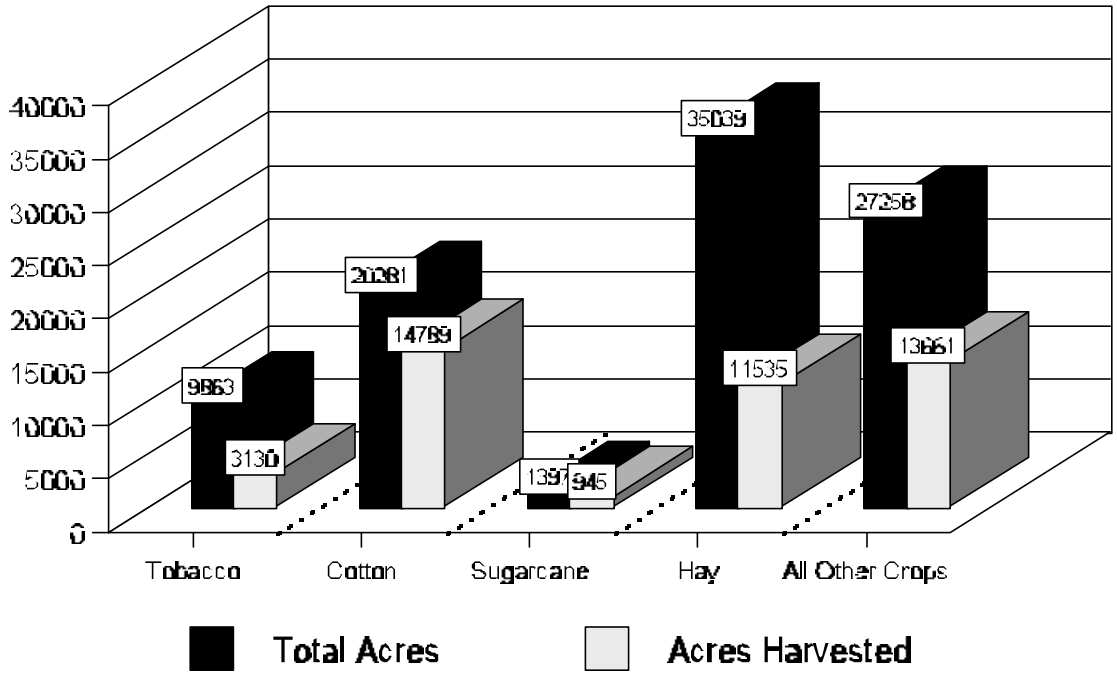


II.B.4. Other Crops

The category of Other Crops comprised the second largest group of crop-producing establishments in the U.S. in 1997. A total of 269,317 farms were classified as NAICS code 1119 - Other Crops Farming. These other crops include tobacco, cotton, sugarcane, and hay, as well as other specialty crops such as honey and sugarbeets. Of the 269,317 other crop farms, 52 percent were classified as hay farms. Tobacco farms accounted for 24 percent of these establishments and cotton-producing establishments represented 7 percent. Sugarcane farms accounted for less than 1 percent of all establishments in this category. The remaining 17 percent were classified in the All Other Crops category.

These establishments combined for a total land area of approximately 94 million acres, or approximately 349 acres per establishment. The average number of acres harvested was 164 acres. Exhibit 12 provides a comparison of total acres to acres harvested for other crops.

Exhibit 12. Total Acres vs. Acres Harvested of Other Crops (in thousands of acres) (1997 Ag Census)



II.C. Characterization of the Greenhouse, Nursery, and Floriculture Production Industry

Although the greenhouse, nursery, and floriculture industry is classified under NAICS code 111, this profile separates it into its own section because its practices and environmental impacts are different from those associated with the crops discussed in Section II.B.

In 1997, according to the Ag Census, there were 57,192 farms classified as NAICS code 1114, which is Greenhouse, Nursery, and Floriculture Production. This industry group consists of establishments that primarily grow crops of any kind under cover and/or grow nursery stock and flowers. "Under cover" is generally defined as in greenhouses, cold frames, cloth houses, and lath houses. The crops grown are removed at various stages of maturity and have annual and perennial life cycles. The nursery stock includes short rotation woody crops that have growth cycles of 10 years or less.

Of the 57,192 establishments classified as NAICS 1114, 97 percent were nursery and floriculture production (NAICS code 11142). The remaining 3 percent were classified as NAICS code 11141 - food crops grown under cover. Within the nursery and floriculture classification, there are two distinct categories:

- ***Nursery and tree production***, which consists of establishments primarily engaged in growing nursery products, nursery stock, shrubbery, bulbs, fruit stock, and sod, and those engaged in growing short rotation woody trees with a growth and harvest cycle of 10 years or less for pulp or tree stock, such as Christmas trees, under cover or in open fields.

- ***Floriculture production***, which consists of establishments primarily engaged in growing and/or producing floriculture products, such as cut flowers, cut cultivated greens (e.g., leatherleaf ferns, chamaedorea, etc.), potted flowering and foliage plants, and flower seeds, under cover or in open fields.

In 1997, there were 33,935 nursery and tree production establishments and 21,824 floriculture establishments. These establishments combined for total sales of nearly $10 billion, or approximately 10 percent of the total value of all crops sold in 1997. The average size of nursery and tree production establishments is nearly 92 acres, with an average of approximately 35 acres being harvested cropland. Floriculture production establishments average 35 acres in size with approximately one-third of that acreage being harvested cropland. California and Florida account for the majority of the establishments, as well as sales, in the floriculture industry.

Exhibits 13 and 14 show the value of greenhouse, nursery, and floriculture production compared to total crop production, and the value of greenhouse, nursery, and floriculture production sales, respectively.

Exhibit 13. Value of Greenhouse, Nursery, and Floriculture Production Compared to Total Crop Production (1997 Ag Census)

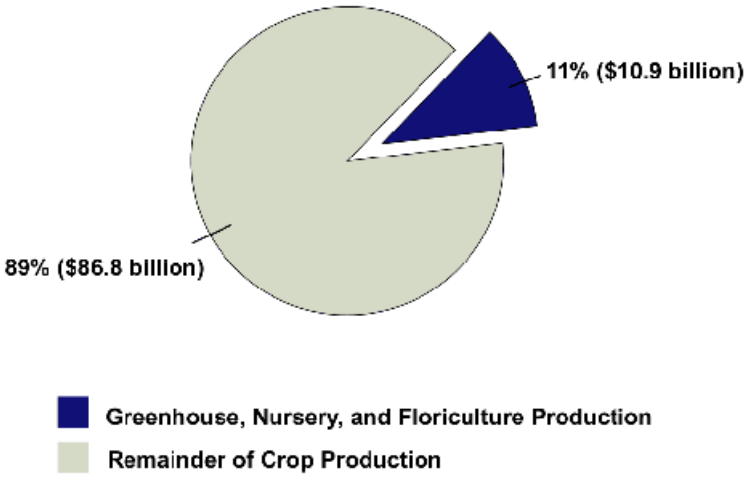
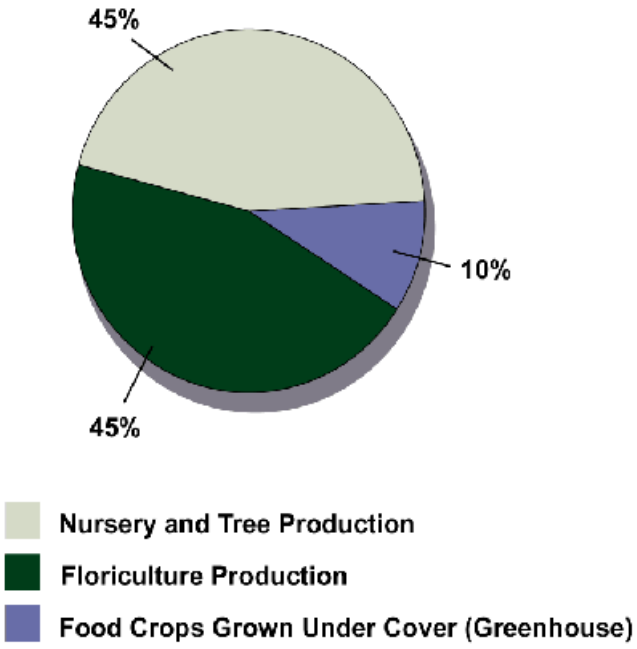


Exhibit 14. Values of Greenhouse, Nursery, and Floriculture Production Sales
(1997 Ag Census)



II.D. Characterization of the Forestry Production Industry

This section pertains to the forestry industry as classified within ***NAICS code 113 - Forestry and Logging***. As defined by NAICS, industries in this sector grow and harvest timber on a long production cycle (i.e., 10 years or more). Long production cycles use different production processes than short production cycles, which require more horticultural interventions prior to harvest, resulting in processes more similar to those found in the previous sections of this profile. The three subsectors included within NAICS code 113 are:

- ***Timber tract operations (NAICS code 1131)***, which consist of establishments engaged in operating timber tracts for the purpose of selling standing timber.

- ***Forest nurseries and gathering of forest products (NAICS code 1132)***, which primarily engage in growing trees for reforestation and gather forest products, such as gums, barks, balsam needles, rhizomes, fibers, Spanish moss, ginseng, and truffles.

- ***Logging (NAICS code 1133)***, which consists of establishments primarily engaged in cutting timber, cutting and transporting timber, and producing wood chips in the field.

Industries usually specialize in different stages of the production cycle, as indicated by the three NAICS codes. Reforestation requires production of seedlings in specialized nurseries. Timber production requires natural forest or suitable areas of land that are available for a long duration. The harvesting of timber (except when done on an extremely small scale) requires specialized machinery unique to the industry. Establishments gathering forest products, such as gums, barks, balsam needles, rhizomes, fibers, Spanish moss, and ginseng and truffles, are also included in this industry.

II.D.1. Definition of Forest Land

The U.S. Forest Service defines a forested area as "forest land" if it is at least one acre in size and *at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use.* (Examples of non-forest uses include areas for crops, improved pasture, residential areas, and other similar areas.) Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10 percent stocked with forest trees and forest areas adjacent to urban and built-up lands (36 CFR 219).

In the United States, there are approximately 736.7 million acres of forest land. The distribution of this forest land among geographic regions is presented in Exhibit 15.

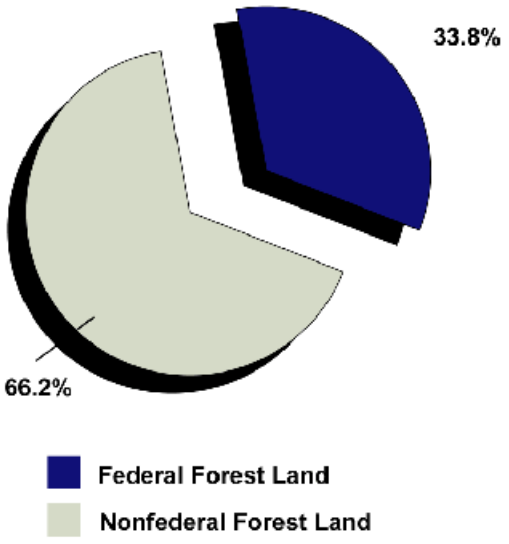
Exhibit 15. Distribution of U.S. Forested Land Area

Geographic Region	Total Land Area (in thousands of acres)	Forested Acres (in thousands)	Percent Forested
Northeast	126,816	85,380	67
North Central	286,764	83,108	29
Pacific Northwest	469,093	177,611	38
Pacific Southwest	103,934	39,011	38
Great Plains	194,299	4,232	2
Southeast	147,419	88,078	60
South Central	387,104	123,760	32
Rocky Mountains	547,918	135,499	25
Total	**2,263,347**	**736,679**	
Source: American Forest and Paper Association (AFPA), 1995			

Federal Versus Nonfederal Forest Lands

Of the 736.7 million acres, approximately 249.1 million acres (or 33.8 percent) are owned by the federal government. The remaining 487.6 million acres are owned by nonfederal entities, such as state or local governments, private citizens, or companies (see Exhibit 16).

Exhibit 16. Federal vs. Non federal Forest Lands (AFPA 1995)



Approximately 57 percent of all productive forest land in the U.S. is owned by 9.3 million non-industrial private landowners. These 353 million acres of land produce more than half of the nation's wood supply (AFPA, 1995).

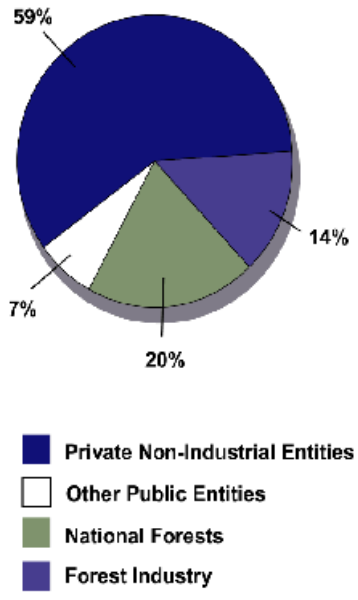
The majority of federal forest land is managed as the national forest system (NFS). The NFS includes:

- National forest lands reserved from the U.S. public domain.
- National forest lands acquired through purchase, exchange, donation, or other means.
- National grasslands.
- Other lands, waters, or interests administered by the U.S. Forest Service (FS) or designated for administration through the FS as part of the system.

The NFS contains 191 million acres, or 77 percent, of federal forest lands. (The remaining federal forest lands are managed by the Bureau of Land Management, the National Park Service, and other federal agencies.) The NFS is contained in 43 states and creates about 500,000 private sector jobs. Of the remaining nonfederal forests, privately held commercial forest lands make up the largest portion accounting for 347 million acres (71 percent).

Timberlands. Two-thirds of U.S. forest lands, or almost 490 million acres, are classified as timberlands. Timberlands are defined as forest lands used for the production of commercial wood products. Commercial timberland can be used for repeated growing and harvesting of trees. Seventy percent of timberlands are located in the East (AFPA, 1995). Exhibit 17 presents additional information about timberland ownership. Of the 490 million acres of timberland, federal, state, and local governments own 131 million acres (27 percent) and non-industrial private entities own 288 million acres (59 percent).

Exhibit 17. Timberland Ownership (AFPA 1995)



Private timberlands are mostly on small tracts of forest land. Only 600,000 landowners have holdings larger than 100 acres (AFPA, 1995). The forest products industry owns about 70 million acres (14 percent) of commercial timberland. One-third of the nation's annual timber harvest is from these forests (AFPA, 1995).

II.D.2. Consumption and Regeneration of Forest Products

The United States is the world's leading producer and consumer of forest products (e.g., paper products) and accounts for approximately one-fourth of the world's production and consumption (AFPA, 1995). The United States is also the world's largest producer of softwood and hardwood lumber. Specifically for timber, in 1996, total annual sales for commercial (i.e., nonfederal) timber and nontimber forest products were approximately $3.8 billion. Timber alone accounted for approximately 69 percent of those sales.

In fiscal year 1998, the NFS sold approximately174 million cubic feet (or 870 million board feet) of timber valued at approximately $80 million. NFS timber sales from the past 6 years are presented in Exhibit 18. Also in fiscal year 1998, BLM sold 43.7 million cubic feet (or 261 million board feet) of timber. (A value was not provided for the BLM timber sales.)

Exhibit 18. NFS Timber Sales, FY 1993-1998
(from U.S. Forest Service)

Fiscal Year	Approx. Volume (million cubic feet)	Value
1993	250	$192,942,739
1994	177	$125,340,385
1995	240	$140,460,250
1996	212	$125,226,853
1997	195	$123,681,846
1998	174	$80,195,720

Exhibit 19. Acres Seeded and Acres of Tree Planting (FY 199)

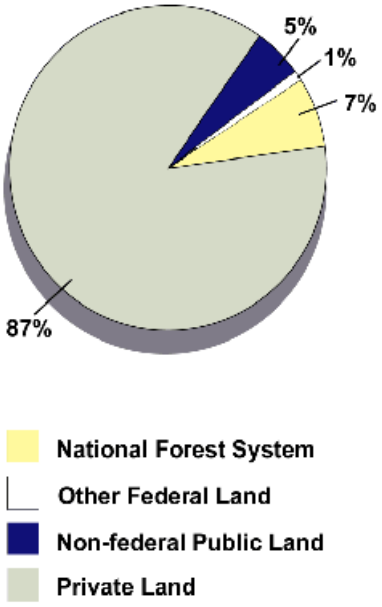


Exhibit 19 provides a breakout of where regeneration efforts occurred. To replenish the forests, more than 2.4 million acres in the U.S. were either seeded or planted with trees in government fiscal year 1996 (October 1995 - September 1996). The overwhelming majority of the regeneration efforts occurred on private lands where nearly 2.1 million acres were seeded or planted.

II.E. Geographic Distribution and Economic Trends

According to the 1997 National Resource Inventory (NRI), some changes have occurred in land use. Since 1982, federal land increased by 4.6 million acres, nonfederal rural land decreased by 36.7 million acres, and developed land increased by nearly 30 million acres. Cropland acreage, classified as irrigated, non-irrigated, cultivated, or non-cultivated acreage, nationally decreased by 45.9 million acres between 1982 and 1997. Rangeland decreased by 12.4 million acres and pastureland decreased by almost 14 million acres. Generally, a shift has occurred in irrigated agriculture from west to east across the country.

The distribution of prime farmland by land cover/use has also changed in the past 15 years. There were 330.6 million acres of prime farmland in 1997, which was down 11.7 million acres from 1982. Most (64 percent) of the prime farmland is in cropland, but large amounts are in pastureland (35.5 million acres) and forest land (47.7 million acres).

For more information from the 1997 NRI, please visit the website http://www.nhq.nrcs.usda.gov/NRI/1997. Additional information on the geographic distribution of the crop production industries and their economic trends is very extensive and available through many sources. National and state-specific information can be accessed through the Internet from the 1997 Agriculture Census at http://www.nass.usda.gov/census/ and the National Agriculture Statistics Service at http://www.usda.gov/nass/.

III. SUMMARY OF OPERATIONS, IMPACTS, AND POLLUTION PREVENTION OPPORTUNITIES FOR THE AGRICULTURAL PRODUCTION INDUSTRIES: CROPS, GREENHOUSES/NURSERIES, AND FORESTRY

This section provides an overview of commonly employed operations and maintenance activities in the agricultural production industries of crops, greenhouses/nurseries, and forestry. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the material inputs, major pollution outputs, and associated environmental impacts from these agricultural production practices. General pollution prevention and waste minimization opportunities are also discussed in the context of each of the operations and maintenance activities.

The choice of practices or operations influences the material used and the resulting pollution outputs and environmental impacts. Keep in mind that environmental impacts are relative, as some kinds of pollution outputs have far greater impacts than others.

Impact of Agriculture on the Environment

The Clean Water Act Plan of 1998 called for the development of the EPA/USDA Unified National Strategy for AFOs to minimize the water quality and public health impacts of AFOs.

According to the *EPA/USDA Unified National Strategy for Animal Feeding Operations* (March 9, 1999), despite progress in improving water quality, 40 percent of the Nation's waterways assessed by States do not meet goals for fishing, swimming, or both. While pollution from factories and sewage treatment plants has been dramatically reduced, the runoff from city streets, agricultural activities, including AFOs, and other sources continues to degrade the environment and puts environmental resources (i.e., surface water, drinking water) at risk. According to EPA's 1996 305(b) water quality report, the top two pollutants from agriculture were identified as sediment and nutrients, respectively. Additional agricultural pollutants, such as animal wastes, salts, and pesticides, were identified by EPA[1]. The following presents a brief discussion of the environmental impacts or effects of agricultural pollutants.

(1) ***Nutrients***. Excess nutrients in water (i.e., phosphorus and nitrogen) can result in or contribute to low levels of dissolved oxygen (anoxia), eutrophication, and toxic algal blooms. These conditions may be

[1] *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, U.S. Environmental Protection Agency, January 1993.

harmful to human health and ecosystems; may adversely affect the suitability of the water for other uses; and, in combination with other circumstances, have been associated with outbreaks of microbes such as *Pfiesteria piscicida*.

- Phosphorus. Phosphorus determines the amount of algae growth and aging that occurs in freshwater bodies. Runoff and erosion can carry some of the applied phosphorus to nearby water bodies.

- Nitrogen. In addition to eutrophication, excessive nitrogen causes other water quality problems. Dissolved ammonia at concentrations above 0.2 mg/L may be toxic to fish. Biologically important inorganic forms of nitrogen are ammonium, nitrate, and nitrite. Ammonium becomes adsorbed to the soil and is lost primarily with eroding sediment. Even if nitrogen is not in a readily available form as it leaves the field, it can be converted to an available form either during transport or after delivery to water bodies. Nitrogen in the form of nitrate, can contaminate drinking water supplies drawn from groundwater. Nitrates above 10 ppm in drinking water are potentially dangerous, especially to newborn infants.

(2) ***Sediment.*** Sediment affects the use of water in many ways. Suspended solids reduce the amount of sunlight available to aquatic plants, cover fish spawning areas and food supplies, clog the filtering capacity of filter feeders, and clog and harm the gills of fish. Turbidity interferes with the feeding habits of fish. These effects combine to reduce fish and plant populations and decrease the overall productivity of waters. In addition, recreation is limited because of the decreased fish population and the water's unappealing, turbid appearance. Turbidity also reduces visibility, making swimming less safe.

(3) ***Animal Wastes***. Animal waste includes the fecal and urinary wastes of livestock and poultry; process water (such as from a milking parlor); and the feed, bedding, litter, and soil with which fecal and urinary matter and process water become intermixed. Manure and wastewater from animal feeding operations have the potential to contribute pollutants such as nutrients (e.g., nitrogen and phosphorus), organic matter, sediments, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment. Decomposing organic matter (i.e., animal waste) can reduce oxygen levels and cause fish kills. Solids deposited in waterbodies can accelerate eutrophication through the release of nutrients over extended periods of time.

Contamination of groundwater can be a problem if runoff results from the misapplication or over application of manure to land or if storage structures are not built to minimize seepage. Because animal feed sometimes contains heavy metals (e.g., arsenic, copper, zinc), the possibility for harmful accumulations of metals on land where manure is improperly or over applied is possible.

(4) ***Salts***. Salts are a product of the natural weathering process of soil and geologic material. In soils that have poor subsurface drainage, high salt concentrations are created within the root zone where most water extraction occurs. The accumulation of soluble and exchangeable salts (i.e., metal compounds in the soil that can chemically change) leads to soil dispersion (i.e., movement of soil in air and water), structure breakdown, decreased infiltration, and possible toxicity; thus, salts often become a serious problem on irrigated land, both for continued agricultural production and for water quality considerations. High salt concentrations in streams can harm freshwater aquatic plants just as excess soil salinity damages agricultural crops.

(5) ***Pesticides.*** The primary pollutants from pesticides are the active and inert ingredients, diluents, and any persistent degradation products. Pesticides and their degradation products may enter groundwater and surface water in solution, in emulsion, or bound to soils. Pesticides may, in some instances, cause impairments to the uses of surface waters and groundwater. Both the degradation and sorption characteristics of pesticides are highly variable. Some types of pesticides are resistant to degradation and may persist and/or accumulate in aquatic ecosystems. Pesticides may harm the environment by eliminating or reducing populations of desirable organisms, including endangered species.

At a crop production establishment, pesticides may be applied directly to crops or to structures (e.g., barns, housing units) to control pests, including parasites, vectors (i.e., an organism, such as a mosquito or tick, that carries disease-causing microorganisms from one host to another), and predators. Potential contamination from pesticides is generally greatest when rainfall is intense and occurs shortly after pesticide application, a condition during which water runoff and soil losses are also greatest. Pesticides can be transported to receiving waters either in dissolved form or attached to soil. Dissolved pesticides may be leached into groundwater supplies.

People, wildlife, and the environment can also be exposed to pesticide residues in the form of spray drift. Spray drift is the physical

movement of a pesticide through air at the time of application or soon thereafter, to any site other than that intended for application. A number of factors influence spray drift including weather conditions, topography, the crop or area being sprayed, and application equipment and methods.

Pesticides are both suspected and known for causing immediate and delayed-onset health hazards for humans. If exposed to pesticides, humans may experience adverse effects, such as nausea, respiratory distress, or more severe symptoms up to and including death. Animals and birds impacted by pesticides can experience similar illnesses or develop other types of physical distress.

Pollution Prevention/Waste Minimization Opportunities in Crop Production, Greenhouses/Nurseries, and Forestry

The best way to reduce pollution is to prevent it in the first place. Industries have creatively implemented pollution prevention techniques that improve operations and increase profits while minimizing environmental impacts. This can be done in many ways such as reducing material inputs, reusing byproducts, improving management practices, and employing substitute toxic chemicals.

To encourage these approaches, this section provides general descriptions of some pollution prevention advances that have been implemented within the agricultural production industries for crops, greenhouses/nurseries, and forestry. While the list is not exhaustive, it does provide core information that can be used as the starting point for establishments interested in beginning their own pollution prevention projects. This section provides information from real activities that may be or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land, and water pollutant releases.

The use of pollution prevention technologies and environmental controls can substantially reduce the volume and concentration of the contaminants released/discharged into the surrounding environment. In some cases, these pollution prevention approaches may be economically beneficial to the agricultural production industries because they decrease the amount of chemicals needed, and therefore the cost of maintaining operations.

Waste minimization generally encompasses any source reduction or recycling that results in either the reduction of total volume or the toxicity of hazardous waste. Source reduction is a reduction of waste generation at the source, usually within a process. Source reduction can include process modifications, feedstock (raw material) substitution, housekeeping and management processes, and increases in efficiency of machinery and equipment. Source reduction includes any activity that reduces the amount of waste that exits a process. Recycling refers to the use or reuse of a waste as an effective substitute for a commercial product or as an ingredient or feedstock in an industrial process.

It should be noted that as individual practices, these pollution prevention and waste minimization practices can significantly reduce the environmental impacts of agricultural operations. However, to get the full effect of the practices and maximize pollution prevention potential, an agricultural operation must consider its individual practices in the context of a system. The practices, ranging from preparing the soil for planting to harvest and post-harvest activities, combine to form an integrated system in which each practice interacts with the others and is affected by the others. That is, outputs from one practice may be inputs into one of the other practices, in effect creating a closed-loop system that both maximizes profits and minimizes environmental impacts. By considering their establishments as systems, operators will be better able to evaluate and implement pollution prevention or waste minimization opportunities.

III.A. Crop Production: Operations, Impacts, and Pollution Prevention Opportunities

The production of crops generally includes the following activities:

- Preparing the site/soil for crops
- Planting/tending crops
- Applying and storing nutrients
- Pest control
- Irrigating crops
- Harvesting crops and post-harvesting activities
- Crop field residue destruction
- Maintaining equipment and vehicles
- Fuel use and fueling activities
- Maintaining the site.

The additional activities of planning and management are required for all of the above processes to occur. Exhibit 20 presents the raw material inputs and pollution outputs from each of these processes.

Exhibit 20. Crop Production Activities, Raw Material Inputs, and Potential Pollution Outputs

Activity	Raw Material Input	Potential Pollution Output
Preparing the site/soil, including tilling, drainage and erosion control structures, and adjusting soil pH	S Mulch, seeds, and water S Alkaline material S Water	S Air emissions (e.g., smoke and dust) S Sediment, nutrient and pesticide runoff from soil erosion S Spilled material or excessively applied material
Planting/tending	S Seed, seedlings	S Air emissions (e.g., dust, emissions from planting equipment) S Sediment, nutrient, pesticide runoff from soil erosion S Plants, branches, leaves, etc.
Applying and storing nutrients (e.g., fertilizers, manure, biosolids)	S Organic nutrients S Chemicals S Water	S Runoff and leaching of unused or misapplied nutrients S Chemical air emissions S Odor
Applying pesticides and pest control	S Pesticides (including insecticides, rodenticides, fungicides, and herbicides)	S Runoff and leaching of unused or misapplied pesticides S Chemical air emissions
Irrigating (not including nutrient application)	S Water S Chemicals	S Air emissions S Potential runoff and leaching of materials (e.g., manure, chemicals, pesticides) from saturated areas
Harvesting/post-harvesting activities, including harvesting; washing, processing, packaging, loading, and transporting products; and destroying crop residue	S Water S Corrugated cardboard S Paper S Plastic and fabric packaging materials	S Unusable or spilled products S Worker exposure to pesticides S Organic- and pesticide-contaminated wastewater S Discarded packaging materials

Exhibit 20. Crop Production Activities, Raw Material Inputs, and Potential Pollution Outputs

Activity	Raw Material Input	Potential Pollution Output
Maintaining and repairing agricultural machinery and vehicles	S Oil S Lubricating fluid S Fuel S Coolants S Solvents S Tires S Batteries S Equipment parts	S Used oil S Spent fluids S Spent batteries S Metal machining wastes S Spent organic solvents S Tires S Air, surface water, and soil pollution resulting from spills and/or releases of fluids S Groundwater pollution resulting from spills or releases of fluids and discharges to Class V wells
Fuel use and fueling activities	S Fuel	S Air emissions from machinery S Air, water, soil, and groundwater pollution resulting from spills
Maintaining the site:		
(1) Providing water, including drinking water and water used for personal hygiene	S Water	S Contaminated water supply
(2) Managing PCBs (i.e., PCBs in generators and equipment)	S PCB-containing oils and equipment	S Spills or releases of PCBs
(3) Renovation/demolition	S Asbestos S Lead	S Airborne asbestos fibers S Lead-based paint, dust, and chips S Soil contamination

III.A.1. Preparing the Site/Soil for Crops

Prior to planting crops, the site/soil must be prepared. Site/soil preparation can involve tilling the soil or chemical cultivation, building drainage and erosion control structures, and adjusting soil pH.

Preparing the Soil by Tilling or Chemical Cultivation

Tilling aerates the soil, allows seeds/seedlings to be placed in the soil, and helps roots take hold of the soil. It also improves drainage and allows for

better assimilation of nutrients and pesticides into the soil. Tillage methods generally consist of intensive/conventional, reduced tillage, and conservation tillage. The difference in the tillage methods is the amount of soil disturbed and the amount of crop residue allowed to remain during the current planting.

- Intensive/conventional tillage is sometimes conducted in two phases – primary tillage with a moldboard plow followed by secondary tillage with a power tiller or disc harrow. Intensive/conventional tillage can range from complete tillage of the entire field to tillage that allows 15 percent of the crop residue to remain.

- Reduced tillage consists of disturbing from 15 to 30 percent of the soil and crop residue.

- Conservation tillage methods are designed to reduce the loss of soil erosion caused by wind and water. Conservation tillage methods allow 30 percent or more of the soil and crop residue to remain undisturbed and thus reduce soil erosion by water and/or maintain at least 1,000 pounds per acre of flat, small grain residue to reduce soil erosion by wind. Common conservation tillage methods are no-till, strip-till, ridge-till, and mulch till.

  - **S** No-till has minimal soil disturbance since the seed is planted with essentially no tillage of the soil and no disturbance of the crop residue.

  - **S** Strip-till involves tillage of a narrow strip of soil and planting of the seed or seedling in that tilled area.

  - **S** Ridge-till methods disturb a narrow strip of soil that was created during previous cultivation. The crop is planted on the ridge and the crop residue remains between each ridge.

  - **S** Mulch-till involves disturbing the entire soil surface and then applying a crop protection product and/or cultivation[2].

In addition to tilling, soil may be prepared for planting by chemical cultivation. Chemical cultivation includes the application of a systematic herbicide to kill weeds and grasses.

[2] 1998 Crop Residual Management Survey Executive Summary, Top 10 Conservation Tillage Benefits, Conservation Tillage Information Center.

Potential Pollution Outputs and Environmental Impacts

The primary pollution output from preparing soil for planting is soil erosion. Erosion can reduce the productivity of the soil and increase the need for additional fertilizer and other inputs. Sediments and other pollutants (e.g., nutrients, pesticides) that are transported offsite may eventually enter surface waters, settle out, and cause degradation of the water quality. When it settles, the sediments fill interstitial spaces in lake bottoms or streambeds. They can eliminate essential habitat, cover food sources and spawning sites, smother bottom-dwelling organisms, and be detrimental to many species of fish. Sediment deposition also reduces the capacity of stream channels to carry water and of reservoirs to hold water. This decreased flow and storage capacity can lead to increased flooding and decreased water supplies.

Sediments can also be suspended in surface waters which causes increased water turbidity. Water turbidity limits the depth to which light can penetrate and adversely affecting aquatic vegetation photosynthesis. Suspended sediments can also damage the gills of some fish species, causing them to suffocate. Turbid waters tend to have higher temperatures and lower dissolved oxygen concentrations. Decreased dissolved oxygen levels can kill aquatic vegetation, fish, and benthic invertebrates.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention opportunities arise from the use of reduced or conservation tillage methods, which reduce soil erosion and maintain the existing soil structure (the way the soil particles clump together into larger, almost crystalline, units). Advantages of conservation tillage include:

- Greater water retention/reduced water usage and energy used for pumping (by increasing the water retention capacity of irrigated soils, there may be opportunities to lengthen periods between irrigation events, thereby saving energy that would otherwise have been used for pumping irrigation water).
- Reduced erosion of sediment and runoff of nutrients.
- Reduced fuel use due to reduced equipment use.
- Reduced wind erosion resulting in less dust.

- Shading which reduces weed growth and subsequent herbicide use. The effectiveness of shading is dependent on the type of crop and distance between plants.

- Prevention of the growth of some molds that have a much lower overwinter survival if not incorporated into the soil.

- Crop residues left undisturbed provide habitats for many beneficial insects and spiders that help control crop predators (e.g., cereal leaf beetle), thereby reducing the need for insecticides. In addition, crop residues help speed the decomposition process and aid plant nutrient cycling.

One possible disadvantage of conservation tillage methods is the carryover of pests (e.g., weeds, diseases, and some insects) in the crop residue. This may result in a subsequent increased use of pesticides and increased level of pesticides in runoff.

Building Drainage and Erosion Control Structures

Erosion control practices are necessary for agricultural operations to control runoff and reduce the amount of soil erosion caused by that runoff. In areas with good drainage, crops are better able to use nutrients and chemicals and will benefit from these optimum growing conditions. When building erosion control structures, newly-graded soil surfaces may be stabilized with mulch prior to the establishment of a vegetative cover.

To establish good drainage, one or a combination of drainage and erosion control structures can be built and used depending on the site characteristics (e.g., slope, crop type, or climate). These structures include:

- *Diversions.* Diversions are vegetated channels across the slope that intercept surface runoff and redirect it along a gradient to a controlled outlet. Diversions can reduce the amount of soil/sediment and related pollutants delivered to surface waters.

- *Grassed waterways*. Grassed waterways, which are shaped or graded to specified dimensions, are used for the stable conveyance of runoff. Grassed waterways can reduce soil erosion in areas, such as gullies or ephemeral gullies, with concentrated flows.

- *Water and sediment control basins.* Water and sediment control basins are constructed to collect and store debris or sediment. They detain

runoff, allowing the sediment to settle out in the basin before the water is discharged to a waterway.

- *Filter strips*. Filter strips are vegetated areas that are used to trap sediment, organic matter, and other pollutants that are carried in runoff. While filter strips require frequent maintenance and have relatively short service lives, they are generally effective in removing pollutants when a shallow sheet flow is passed through the vegetated areas.

- *Riparian buffers*. Herbaceous or forest riparian buffers are areas of grasses, shrubs, or trees placed upgrade from waterways and water bodies. These buffers prevent or minimize damage to surface waters by containing eroded sediment, chemicals, nutrients, and organics. In addition, buffers reduce the amount of these pollutants that leach into shallow groundwater.

- *Terracing and contouring*. Terracing and contouring are practices that both use sloped surfaces to reduce or control soil erosion. Terracing involves shaping an area so that it is sloped, and contouring involves moving soil in an area so that it is sloped.

- *Drainage tiles*. Surface and subsurface drainage tiles are often used to remove standing water from fields and direct them to more structured erosion control measures.

Potential Pollution Outputs and Environmental Impacts

As described above for tilling, soil erosion and its impact to surface waters is a significant environmental concern and the primary pollution from building drainage structures. Wetlands, the interface between terrestrial and aquatic systems, are particularly susceptible to impacts from runoff and soil erosion. Such impacts include damage to watershed hydrology and water quality, and the habitat for many animal and plant species.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention opportunities of drainage and erosion control structures are the minimization of soil erosion and the reduction of runoff which transports nutrients, sediments, and pesticides to the environment.

> Preventing or controlling erosion is based on two main concepts: (1) disturb the smallest area of land possible for the shortest period of time, and (2) stabilize the disturbed soils to prevent erosion from occurring.

Drainage and erosion controls can reduce the amount of sediment that is transported offsite in runoff. Any of the drainage and erosion control structures described above can be used to reduce soil erosion and transport. Additional examples of erosion control structures or activities include: field borders; grade stabilization structures; sediment retention ponds; reestablished wetlands; immediate seeding, mulch/mats, and sodding to stabilize exposed soil surfaces; wind erosion controls; and scheduled grading and shaping (e.g., construction of diversions) during dry weather.

Adjusting the Soil pH

Adjusting the soil pH helps ensure the soil contains the proper characteristics to maximize crop production. Many crop producers add materials to soil to achieve a soil pH that maximizes crop production. Typically, alkaline materials, such as lime, lime sulfur, caustic soda, caustic potash, soda ash, magnesia, and dolomitic lime, are added to increase the pH in acidic soils.

Potential Pollution Outputs and Environmental Impacts

The adjustment of soil pH typically results in little to no pollution outputs and generally has little to no environmental impacts. However, impacts to surface waters could occur if spilled or misapplied alkaline materials are carried in runoff.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention opportunities for this activity include properly storing the materials used to adjust pH to minimize spills, and applying these materials in a manner that minimizes runoff.

III.A.2. Planting/Tending Crops

Planting involves the placement of seeds or seedlings into the soil. This activity can be conducted either by hand (in small operations) or mechanically. Tending the product involves any post-planting activities designed to maximize crop production at harvest. Tending may involve hand labor (e.g., hoeing or pruning) or machine labor.

Potential Pollution Outputs and Environmental Impacts

Pollution outputs from planting crops include air emissions, particularly dust, and wastes such as seed bags. The planting process is often combined with other operations, such as tilling or fertilizer/pesticide application, which can pollute surface waters and groundwater from runoff and leaching, respectively. Tending activities that disturb the soil may result in soil erosion, the impacts of which are similar to those previously discussed under tilling. Tending may also produce wastes (e.g., plant branches or other parts).

Pollution Prevention/Waste Minimization Opportunities

Air emissions from planting activities can be minimized by properly maintaining farm machinery. Sections III.A.7 details how to operate and maintain farm vehicles and machinery in an environmentally responsible manner.

By buying seeds in greater bulk, farms can reduce the volume of seed bags that must be disposed of. Also, certain innovative methods of collecting and dispersing seeds are now available that eliminate the need for bags.

III.A.3. Applying Nutrients to Crops

During various phases of crop production, nutrients such as nitrogen, phosphorus, potassium, and other nutrients are applied to crops to enhance crop growth. Nutrient use has been encouraged by the adoption of high-yielding seeds that are more responsive to nutrient application. Therefore, nearly all acres planted with crops are treated with one or more sources of nutrients, such as fertilizers, manure, and/or biosolids.

Nutrients are applied directly to plants or the soil surface, incorporated or injected into the soil, or applied with irrigation water. Nutrient application methods are mechanically intensive, requiring coverage of vast areas. Fertilizers may be solids, liquids, or gasses and, depending on the state of the product, may be applied using specialized trucks, tractors pulling sprayer equipment, or pressurized tanks to apply anhydrous ammonia. Techniques used to apply fertilizer include:

- *Band placement* is used to locate the fertilizer in an optimum position relative to the seed. This increases the potential for full utilization of the fertilizer by the crop and minimizes salt injury to the developing roots.

- *Broadcast application* refers to the practice of distributing the product uniformly over the soil surface. This method is preferred for lawns and forage and pasture crops and is the most common method used for crops. Tractors, airplanes, and helicopters are all used to broadcast fertilizers.

- *Manure injection* refers to the application of anhydrous ammonia. At normal pressure, anhydrous ammonia (NH_3) is a gas. For application as a fertilizer, it is pressurized to form a liquid. Because it is a volatile liquid, it is incorporated into the soil as a liquid under pressure to a depth of 15 to 25 cm. In the soil, NH_3 is converted to NH_4^+, which is stable. Gaseous ammonia is lost if soil pH increases much above 7, or as moisture fluctuates from field capacity. Liquid manure may be subsurface injected.

- *Addition of fertilizer to irrigation water (i.e., fertigation)* is a common practice in some areas and is usually part of a drip irrigation system that can apply water and fertilizer to a precise predetermined location.

- *Manure and biosolids* may be applied to the soil surface as a solid from a tractor-pulled box-type manure spreader as it makes passes across the field. Slurry manure and biosolids are generally applied to the soil surface by tractor-pulled or truck flail spreaders or to the subsurface by tractor or truck injection equipment. Liquid manure may be surface irrigated or subsurface injected. Manure and biosolid solids and slurries may be mechanically incorporated into the soil following application.

Potential Pollution Outputs and Environmental Impacts

There are several potential pollution outputs and environmental impacts from nutrient application and spills including runoff and leaching of nutrients which can contaminate surface water and groundwater; air emissions; and increases in the amount of soluble salts in soils. Runoff and leaching of nutrients typically occur when nutrients are applied excessively or improperly. Excessive amounts of soluble salts in the soil can prevent or delay seed germination, kill or seriously retard plant growth, and possibly render soils and groundwater unusable.

The degree of environmental impacts can depend on the application method. The surface application of fertilizer, manure, or biosolids is more likely to result in runoff than injection. Non-composted surface-applied manure will volatilize and release ammonia to the air. Spills

of nutrients may also negatively impact the environment since they will be concentrated in one specific area.

Pollution Prevention/Waste Minimization Opportunities

There are several pollution prevention techniques that can be used to reduce pollution and impacts from nutrient application. These include:

- Application methods that prevent runoff (e.g., application by injection).
- Restricting application in close proximity to surface waters.
- Applying nutrients at agronomic (scientifically determined) rates to crops/cropland.
- Managing the site to eliminate erosion or reduce the runoff potential.
- Developing and implementing **nutrient management plans**. The primary purpose of nutrient management is to achieve the level of nutrients (e.g., nitrogen and phosphorus) required to grow the planned crop by balancing the nutrients that are already in the soil with those from other sources (e.g., manure, biosolids, commercial fertilizers) that will be applied. At a minimum, nutrient management can help prevent the application of nutrients at rates that will exceed the capacity of the soil and the planned crops to assimilate nutrients and prevent pollution.

  A site-specific nutrient management plan should be developed prior to planting, reviewed annually, and updated as needed. The plan, which will direct the application of one or more nutrients to the cropland, may include:

  - Soil and field maps that show setbacks and buffers, as well as wetland and groundwater maps
  - Crops and rotations
  - Soil tests
  - The calculated nutrient loading for each field

  Additional plan components may consist of manure and biosolid test results; projected manure production, storage, and

treatment; commercial fertilizer needs; application rates; and the method and timing of application.

Soils, manure, and wastewater should be tested to determine nutrient content. Retesting should be completed following each significant change in the manure/biosolids source or manure waste management system.

- **Precision farming.** One of the more advanced technologies for improving nutrient application efficiency is known as precision farming. Typically used by larger operations, precision farming allows farmers to know their location in the field via a Global Positioning System (GPS) so that applications can be made according to a predetermined rate for that specific location. Precision farming may result in more precise applications of nutrients so there is little or no excess leached to groundwater or washed to surface waters.

III.A.4. Applying Pesticides and Pest Control

Pesticides (e.g., insecticides, herbicides, fungicides) may be applied during all phases of crop production, including during harvesting and post-harvesting activities. For crop production, pesticides prevent insects and other pests, including weeds and other unwanted plants, from harming crops. Pesticide use has been encouraged by continuous cropping, which has created favorable pest habitats in certain crops.

Pesticide application methods for crops are mechanically intensive, requiring coverage of vast areas. Pesticides are applied directly to the plant or soil surface, incorporated into the soil, or injected as a gas through fumigation. One of the most common methods of applying pesticides to crops is liquid spraying. Liquid spraying may be conducted by aircraft, tractor spray rigs, or blasters.

- Aerial methods are the most common application type with about two-thirds of all insecticides and fungicides applied in this manner.

> Citrus groves may be aerially treated 10 to 20 times per season with insecticides, fungicides, and protectant oils.

- Helicopters are often used because the turbulence from the main rotor tends to push the pesticides down toward the crop.

- S Fixed-wing aircraft are more commonly used in crops such as wheat and cotton.

- Tractor spray rigs are often used to apply herbicides in row crops because planting, fertilizing, and spraying can be accomplished in one pass through the field.

- Blasters are used for applying insecticides and fungicides to tree crops.

Other than the Agency's ultra-low volume exemption, concentrated pesticides must be applied according to label directions including any requirement to mix with a diluent or water. The mixing and subsequent loading into the application vehicle must be conducted in a contained area.

Biopesticides. Biopesticides (also known as biological pesticides) are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. At the end of 1998, there were approximately 175 registered biopesticide active ingredients and 700 products. Biopesticides fall into three major classes:

- *Microbial pesticides* contain a microorganism (e.g., a bacterium, fungus, virus, or protozoan) as the active ingredient. These pesticides can kill many different kinds of pests. For example, there are fungi that control weeds, other fungi that control cockroaches, and bacteria that control plant diseases. The most widely used microbial pesticides include various types of the bacterium *Bacillus thuringiensis*, or Bt. Bt acts by producing a protein that kills the larvae of specific insect pests. One kind of Bt can control specific insects in cabbage, potatoes, and other crops, while another type of Bt kills mosquitoes. Based on available information, the bacterium appears to have no adverse effects on humans or the environment. However, additional data are needed to ensure that products containing this bacterium are safe for honey bees, wasps, fish, and aquatic invertebrates.

- *Plant pesticides* are pesticidal substances that plants produce from genetic material that has been added to the plants. For example, scientists can introduce the gene for the Bt pesticidal protein into a plant's genetic material. The plant will then manufacture the substance that destroys the pest. Both the Bt protein and its genetic material are regulated by EPA; the plant itself is not regulated.

- *Biochemical pesticides* are naturally occurring substances that control pests by nontoxic mechanisms. In contrast, conventional pesticides are synthetic materials that usually kill or inactivate the pest. Biochemical pesticides include substances, such as pheromones, that interfere with the growth or mating of a pest. Because it is sometimes difficult to determine whether a natural pesticide controls the pest by a nontoxic mode of action, EPA has established a committee to determine whether a pesticide meets the criteria of a biochemical pesticide.

Some of the advantages of using biopesticides are:

- They are inherently less harmful than conventional pesticides.
- They generally affect only the target pest and closely related organisms.
- They are often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides.

To use biopesticides effectively, users should have a solid understanding of how to manage pests. When used as a component of integrated pest management (IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while still allowing crop yields to remain high.

Potential Pollution Outputs and Environmental Impacts

Environmental impacts most likely result from pesticide applications that are not conducted according to label directions. Potential pollution outputs and environmental impacts from pesticide application may include:

- Runoff or leaching of pesticides to surface water or groundwater. Pesticides incorporated into soil may leach into the groundwater. Soil fumigants will include releases to groundwater through leaching. Pesticides applied through chemigation, in which the pesticide is combined and applied with irrigation water, may be released to surface water through runoff or to groundwater through leaching.
- Air emissions. The application of pesticides using spray systems is more likely to involve releases to air. Soil fumigants will include releases to air through volatilization.

- Spills to soil and surface waters. The impacts of spills may be more significant since the spilled materials will be concentrated in one specific area.

- Potential human exposure and residue levels that exceed tolerance on animals and products. Pesticides are both suspected and known for causing immediate and delayed-onset health hazards for humans. If exposed to pesticides, humans may experience adverse effects, such as nausea, respiratory distress, or more severe symptoms up to and including death. To help reduce this potential exposure, tolerance levels have been established for residues on agricultural products. Animals and birds impacted by pesticides can experience similar illnesses or develop other types of physical distress. Following label directions for application, protective gear, and disposal will help ensure such environmental impacts do not occur.

- Pesticides that are applied to water-saturated soils or highly alkaline soils may not degrade as quickly as those applied properly or with the appropriate pH additive. When pesticides do not degrade, or do not bond with the plant or soil surface, they are more likely to be released to the environment through runoff.

- If not protected with backflow prevention devices, pesticides applied through spray systems that are connected to water supplies can siphon back to the water source and potentially contaminate drinking water systems. Also, improperly cleaned and disposed pesticide containers may cause releases to the soil and/or surface waters.

- Outputs from pesticide applications can inhibit crop production through the resurgence of pests after treatment, occurrence of secondary pest outbreaks, and development of pesticide resistance in target pests. In addition, the control of insects by broad-spectrum insecticides also destroys beneficial insect populations. Populations of many previously innocuous species may then increase rapidly and cause major economic damage.

- Crop losses have occurred when pesticides were applied improperly or drifted from a treated crop to nearby susceptible crops; when excess residues prevent crops from being planted

in rotation or inhibit the growth of susceptible crops; and when excessive residues of pesticides accumulate on crops, causing the harvested products to be unmarketable.

Pollution Prevention/Waste Minimization Opportunities

Environmental impacts from pesticides are minimized by following label directions for application, and preventing or minimizing their use wherever possible. Pesticide use accounts for a substantial portion of farm production costs. By reducing their use, agricultural establishments cannot only reduce production costs, but also reduce environmental impacts of their operations.

Pesticide use and impact can also be minimized by using integrated pest management approaches, new technologies, efficient application methods, controls, and basic preventive measures. Examples of these are presented below.

- **Integrated pest management (IPM).** IPM is an effective and environmentally sensitive approach to pest management that relies on a combination of common sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

  Crop management is a vital part of IPM because it may reduce the concentration of pests. Crop rotation can help prevent disease buildup. Rotation is particularly important when conservation tillage methods are used. For grain crops, other methods include planting of hybrid plants that are resistant to leaf blights and stalk rot, plowing under chopped corn stalks and leaves (which can kill some overwintering disease fungi, but also may promote the growth of others that live below the surface), and maintaining good drainage. An IPM plan should indicate that when a pesticide is needed, and its selection is based on persistence, toxicity, and leaching and runoff potential such that the most environmentally friendly pesticide is used.

- **Precision farming.** One of the more advanced technologies for improving nutrient and pesticide application efficiency is known as precision farming. Typically used by larger operations, precision farming allows farmers to know their

location in the field via a Global Positioning System (GPS) so that applications can be made according to a predetermined rate for that specific location. Precision farming may result in more precise applications of nutrients and pesticides so there is little or no excess leached to groundwater or washed to surface waters.

- **Controlled droplet application (CDA).** CDA produces spray droplets that are relatively uniform in size and allows the applicator to control droplet size. In contrast, conventional spray nozzles produce droplets that vary widely from small droplets that may drift or evaporate before reaching the target, to large droplets that concentrate too much of the pesticide in one spot. CDA improves the efficiency of pesticide application, thus reducing overall pesticide use and cost. In addition, CDA may require less than one gallon of water per acre, compared with 20-30 gallons per acre with most conventional herbicide sprayers. CDA also provides time and fuel savings as well as less soil compaction. (Cornell University, Dr. Russel R. Hahn, *Controlled Droplet Application*)

- **Chemigation**. Another method of more efficient pesticide application is chemigation. Chemigation systems are irrigation systems that are designed for chemical application by injection with the irrigation water. The systems provide reduced water pollution by allowing prescription chemical applications to be made. If chemicals are applied frequently and only in amounts required by the irrigated crop, the presence of excessive amounts are avoided, thus preventing leaching from occurring. (University of Florida Cooperative Extension Service, 1993)

- **Erosion control devices.** To control pesticide losses to surface water, a farm should control erosion and reduce the volume of runoff water that leaves the field or farm. Practices such as conservation tillage, terraces, strip-cropping, and contouring reduce runoff and control erosion. Sediment basins, farm ponds, and wetlands contain or trap sediments. Keeping the chemicals in the field or trapping them in biologically active areas (e.g., ponds or wetlands) provides the opportunity for microorganisms to degrade the pesticides, eventually rendering them harmless.

- **Basic preventive measures**. Waste minimization strategies for pesticides include:
  - Buy only the amount needed for a year or a growing season.
  - Minimize the amount of product kept in storage.
  - Calculate how much diluted pesticide will be needed for a job and mix only that amount.
  - Apply pesticides with properly-calibrated equipment.
  - Use all pesticides in accordance with label instructions.
  - Purchase pesticide products packaged in such a way as to minimize disposal problems.
  - Work with the state to locate a pesticide handler who can use the excess pesticide.
  - Return unused product to the dealer, formulator, or manufacturer.
  - Implement setbacks from wellheads for application and storage.
  - Use contact pesticides that do not have to be incorporated into the soil.
  - Use row banding application techniques, where appropriate, to limit the amount of pesticide applied.
  - If possible, choose nonleachable pesticides labeled for the crop and pest. Nonleachable pesticides are considered those that are less likely to migrate from their target crop.

III.A.5. Irrigating Crops

Irrigation has always been a component of crop production and provides many benefits. Over the past 150 years, the practice of irrigation has increased dramatically, increasing the number of farmable acres, producing consistent and often higher yields, and making agriculture possible in areas previously unsuitable for intensive crop production.

Irrigation transports water to crops primarily for growth, but also to ease the shock following transplant and to keep the crops cool in arid or excessive heat conditions.

In addition to these recognized benefits of irrigation, other factors have contributed to the increase in its use. Investment in equipment to transport water for agricultural use has been stimulated by federal policies. Such policies have included high commodity support prices, tax incentives that include investment credits, and accelerated depreciation for equipment, water depletion allowances, and low interest rates.

In the western United States, irrigation has been encouraged by federal law, which has provided subsidized irrigation water to western growers for nearly a century. As this and other subsidy programs have declined, the number of irrigated acres has decreased. However, in the eastern states that have not received direct water subsidies in the past, the number of irrigated acres is expected to increase.

There are many different irrigation systems, all of which are designed to move water from its source to where it can be used for crop production. Irrigation water is typically obtained from pumping groundwater or surface waters from onsite sources or from offsite sources such as rivers, pipelines, canals and aqueducts that are operated by irrigation districts and private water companies. Irrigation methods may consist of flood, stationary, and traveling systems.

- Flood systems allow the water to gravity sheet flow across the cropland.

- Stationary systems include subsurface drip or trickle systems and aboveground systems, which are permanently piped and may or may not have spray heads.

- Traveling systems may be center pivot, linear-move, hard-hose, or cable-tow. Irrigation systems such as the center pivot and linear-move usually have multiple spray heads (guns). Hard-hose and cable-tow systems usually have a single spray head.

Potential Pollution Outputs and Environmental Impacts

The potential pollution outputs from irrigation include runoff and leachate contaminated with pollutants (e.g., nutrients and pesticides) and salinization. Water depletion is one of the significant environmental impacts of irrigation. Irrigation can deplete surface water supplies, not only from the removal of water from these sources to use for irrigation, but also from the reduced volume of water returning to surface water due to evaporation losses. Irrigation can also deplete groundwater supplies. Water tables have fallen, particularly in drier western states, because of large volumes of groundwater being used for irrigation. Not only has this resulted in less water for agriculture and other uses, it has also resulted in an increase in the cost of water for all users. Land subsidence of up to 10 feet has resulted in some areas because of groundwater withdrawals occurring at rates that exceeded groundwater recharge.

Irrigation contributes to the movement of nutrients and pesticides into surface waters and groundwater, particularly in sandy soils. The impacts of pollutants (e.g., nutrients, pesticides, and sediments) from irrigation-induced runoff are similar to those discussed in Section III.A.1.

Mineralization and salinization of soils are additional impacts of irrigation. Irrigation water, whether from groundwater or surface water sources, has a natural base load of dissolved mineral salts. As the water is consumed by plants or lost to the atmosphere by evaporation, the salts remain and become concentrated in the soil. This is referred to as the "concentrating effect." The total salt load carried by irrigation return flow is the sum of the salt remaining in the applied water plus any salt picked up from the irrigated land. Irrigation return flows provide the means for conveying the salts to the surface water or groundwater supplies. If the amount of salt in the return flow is low in comparison to the total stream flow, water quality may not be degraded to the extent that use is impaired. However, if the process of water diversion for irrigation and the return of salinated water is repeated many times along a surface water, water quality will be progressively degraded for downstream irrigation use as well as for other uses. In the western states, major aquifers have been depleted or destroyed through salinization, or when withdrawals exceeded recharge rates.

Pollution Prevention/Waste Minimization Opportunities

There are several pollution prevention opportunities for irrigating crops. First, minimizing the use of irrigation will reduce erosion,

runoff, groundwater depletion, and salinization. It can also save money by reducing the costs associated with irrigation. Other pollution prevention techniques include:

- *Using well-designed irrigation systems*. A common cause of environmental impacts from irrigation is poor system design. Poorly designed systems may apply water nonuniformly, allowing some areas to become oversaturated while others do not receive adequate water. Areas not adequately irrigated may suffer yield or quality reductions, while overirrigated areas may suffer from the leaching of chemicals.

- *Using efficient irrigation systems*. There are several types of efficient irrigation systems, including surge irrigation systems and drip irrigation systems.

  - With surge irrigation, water is sent through the furrows between each row of crops. Rather than sending all the water at once, small amounts are sent in bursts. In this manner, erosion is reduced, more water reaches the plant, and less runoff of irrigated water occurs.

  - In drip irrigation, plants are watered directly from the irrigation source. While drip irrigation conserves water, by watering only the plants' fruits and the soil immediately around them, drip irrigation can also lead to soil erosion. If drip irrigation is the sole method used, the soil between rows of crops remains dry, thus making it more susceptible to wind erosion.

The Texas Agricultural Extension Service has found irrigation efficiency for surge irrigation up to 90 percent and drip irrigation to be up to 98 percent. These systems significantly reduce the amount of irrigation water that can runoff to surface waters, thus reducing pollution. Conventional systems have a much lower efficiency rate. The efficiency of all methods can be improved by varying application volumes as water tables rise and fall.

Calculating Fuel Use Efficiency for Irrigation Pumps

The Texas Agricultural Extension Service has developed a program to determine the efficiency of various irrigation methods. The program calculates a pumping plant's fuel use efficiency performance and compares it to a given standard. The program also calculates the fuel cost per acre-inch pumped and fuel cost savings if a pumping system is brought up to the performance standard. The program can be used to evaluate the pumping performance and fuel cost for the following fuels: (1) electricity, (2) natural gas, (3) diesel, (4) gasoline, (5) propane, and (6) butane.

In addition to well-designed and efficient irrigation systems, there are many inexpensive best management practices that can be used to reduce runoff and erosion, and lower irrigation costs. These methods include the following:

- Assure all irrigation systems are in good repair, with no leaks, and that the sprinklers are adjusted to minimize misdirected spray.
- Use low-volume spray heads and stop watering if puddling and runoff is observed.
- Irrigate early in the morning or in the evening when it is generally less windy and cooler.
- Utilize efficient irrigation methods such as drip irrigation. Many existing spray systems can be changed to function as drip systems.
- Install check valves to prevent downhill sprinkler heads from draining after the system has been shut off. This keeps water in the pipes for the next sprinkling. Follow manufacturer's instructions.
- Install "rainguards" that measure rainfall and stop operation of the irrigation controller during rainfall.
- If nutrients are irrigated, calculate the discharge rate of the system and irrigate only at desired loading.
- Replace worn irrigation nozzles (increased orifice size) that may result in over application.

III.A.6. Harvesting Crops and Post-Harvesting Activities

Harvesting crops involves digging, cutting, picking, or other methods of removing the crops from the ground, stalks, vines, or trees. Small fruits and other food crops (e.g., strawberries, melons) are typically harvested by hand, though may be harvested by machine. Field crops (e.g., corn, barley, oats) are typically harvested by machine. For specific crops, such as sugar cane, pre-harvest burning may be conducted to improve access to the crop.

Post-harvesting activities include washing and processes products; packaging, loading, and transporting products; and destroying crop residue (if appropriate).

- *Washing, processing, and packaging products*. Crops may be washed at the agricultural establishment or at the processing plant. Fresh agricultural crops may be washed at the agricultural establishment and then shipped directly to distribution centers or sales outlets. Agricultural crops destined for use as processed foods (e.g., canned fruits and vegetables or snack foods), are likely to undergo extensive washing and processing at the processing plant. Unusable crops can either be picked up manually or separated out from the usable stock after the washing process.

  Following processing, crops are packaged and prepared for delivery to the appropriate customer. Crops such as tobacco require drying during the onsite curing processing. Crops may be packaged using various materials, including corrugated cardboard, paper, and plastic/fabric packaging materials.

- *Loading and transporting products*. While the loading operation will vary between establishments, individually packaged crops (e.g., berries), are commonly loaded by forklift or by hand, while bulk packaged crops (e.g., potatoes and apples) may be loaded by conveyor. Crops are then transported typically by truck or rail to their final destination.

- *Destroying crop residue*. Post-harvest crop residue destruction is a practice used for specific crops, particularly in certain areas of the United States. For example, rice and wheat stubble are often burned in the southeast and northwest respectively after harvest is complete.

Potential Pollution Outputs and Environmental Impacts

The potential pollution outputs of harvesting and post-harvesting activities include air emissions from harvesting equipment and crop residue burning; unusable or spilled crop; wastewater potentially contaminated with organic wastes and pesticides from crop washing; wastewater and waste product from processing; and damaged or unusable packaging materials. If discharged to surface waters, wastewater from crop washing can potentially cause BOD contamination. Damaged or unusable packaging and unusable/spilled crop may be managed as solid waste. Hydraulic lifts or conveyors used in the loading process may leak oil, resulting in soil contamination.

Pollution Prevention/Waste Minimization Opportunities

There are several pollution prevention and waste minimization opportunities for harvesting and post-harvesting activities. These include:

- *Maintaining harvesting machinery and vehicles*. Section III.A.7. *Maintaining and Repairing Agricultural Machinery and Vehicles* discusses various methods of keeping an environmentally responsible farm vehicle.

- *Using unusable product as nutrients*. Unusable products can be washed to remove pesticides and then composted for future use as nutrients. This can prevent the disposal of these products as solid wastes and reduce the amount of commercial fertilizers used.

- *Minimizing water use for product washing*. Minimizing the amount of water used for product washing can reduce potential BOD contamination and reduce water costs. There are several types of equipment that can be used to minimize water use including control faucets and sprayers. These faucets and sprayers control the flow of water, using significantly less water than the faucets that supply a continuous flow of water. Other simple techniques to minimize water use include the following:

  - Installing a time sequence sprayer that can minimize the amount of water being used.

  - Using a high-pressure, low-flow nozzle during cleaning to significantly reduce water use.

- **S** Installing sideboards or splash guards to prevent spillage.
- **S** Shutting the water off during breaks.

- **T** *Prevent contamination from oil leaks*. Place catch pans underneath hydraulic lifts or conveyors to collect oil leaks and prevent soil contamination. This oil can then be recycled.
- **T** *Prevent product spills.* The use of sideboards on conveyors or other equipment designed to transport products from the ground into the vehicle can be used to prevent product spills. Additionally, catch pans or containers underneath loading areas can be used to collect any unusable products left on the ground. These products can then be composted, if appropriate.

III.A.7. Maintaining and Repairing Agricultural Machinery and Vehicles

Day-to-day maintenance and repair activities keep agricultural machinery and vehicles safe and reliable. Maintenance activities include oil and filter changes, battery replacement, and repairs, including metal machining.

Potential Pollution Outputs and Environmental Impacts

The wastes from maintenance and repair activities can include used oil, spent fluids, spent batteries, metal machining wastes, spent organic solvents, and tires. These wastes have the potential to be released to the environment if not handled properly, stored in secure areas with secondary containment, protected from exposure to weather, and properly disposed of. If released to the environment, the impact of these releases can be contamination of surface waters, groundwater, and soils, as well as toxic releases to the atmosphere. Groundwater pollution can also result from discharges of wastes to Class V wells.

Proper Disposal of Oil-Based Fluids. Spent petroleum-based fluids and solids should be sent to a recycling center whenever possible. Solvents that are hazardous waste must not be mixed with used oil or, under RCRA regulations, the entire mixture may be considered hazardous waste. Non-listed hazardous wastes can be mixed with waste oil, and as long as the resulting mixture is not hazardous, can be handled as waste oil. All used drip pans and containers should be properly labeled.

Pollution Prevention/Waste Minimization Opportunities

Preventive maintenance programs can minimize waste generation, increase equipment life, and minimize the probability of significant impacts and accidents. Where the wastes cannot be eliminated, safe handling and recycling can minimize environmental impacts. The following presents pollution prevention/waste minimization opportunities for each type of waste.

Used Oil. The impact of oil changes can be minimized by preventing releases of used oil to the environment, and recycling or reusing used oil whenever possible. Spills can be prevented by using containment around used oil containers, keeping floor drains closed when oil is being drained, and by training employees on spill prevention techniques. Oil that is contained rather than released can be recycled, thus saving the farm money, and protecting the environment.

Recycling used oil requires equipment like a drip table with a used oil collection bucket to collect oil dripping from parts. Drip pans can be placed under machinery and vehicles awaiting repairs to capture any leaking fluids. By using catch pans or buckets, rather than absorbent materials to contain leaks or spills of used oil, the used oil can be more easily recycled. To encourage recycling, the publication "How To Set Up A Local Program To Recycle Used Oil" is available at no cost from the RCRA/Superfund Hotline at 1-800-424-9346 or 1-703-412-9810.

Spent Fluids. Farm machinery and vehicles require regular changing of fluids, including oil, coolant, and others. To minimize releases to the environment, these fluids should be drained and replaced in areas where there are no connections to storm drains or municipal sewers. Minor spills should be cleaned up prior to reaching drains. Used fluid should be collected and stored in separate containers. Fluids can often be recycled. For example, brake fluid, transmission fluid, and gear oil are recyclable. Some liquids are able to be legally mixed with used motor oil which, in turn, can be reclaimed.

During the process of engine maintenance, spills of fluids are likely to occur. The "dry shop" principle encourages spills to be cleaned immediately so that spilled fluid will not evaporate to air, be transported to soil, or be discharged to waterways or sewers. The following techniques help prevent and minimize the impact of spills:

- Collect leaking or dripping fluids in designated drip pans or containers. Keep all fluids separated so they may be properly recycled.

- Keep a designated drip pan under the vehicle while unclipping hoses, unscrewing filters, or removing other parts. The drip pan prevents splattering of fluids and keeps chemicals from penetrating the shop floor or outside area where the maintenance is occurring.

- Immediately transfer used fluids to proper containers. Never leave drip pans or other open containers unattended.

Radiator fluids are often acceptable to antifreeze recyclers. This includes fluids used to flush out radiators during cleaning. Reusing the flushing fluid minimizes waste discharges. If a licensed recycler does not accept the spent flushing fluids, consider changing to another brand of fluid that can be recycled.

Batteries. Farm operators have three options for managing used batteries: recycling through a supplier, recycling directly though a battery reclamation facility, or direct disposal. Most suppliers now accept spent batteries at the time of new battery purchase. While some waste batteries must be handled as hazardous waste, lead acid batteries are not considered hazardous waste as long as they are recycled. In general, recycling batteries may reduce the amount of hazardous waste stored at a farm, and thus reduce the farm's responsibilities under RCRA.

The following best management practices are recommended to prevent used batteries from impacting the environment prior to disposal:

- Place on pallets and label by battery type (e.g., lead-acid, nickel, and cadmium).

- Protect them from the weather with a tarp, roof, or other means.

- Store them on an open rack or in a watertight secondary containment unit to prevent leaks.

- Inspect them for cracks and leaks as they come to the farm. If a battery is dropped, treat it as if it is cracked. Acid residue from cracked or leaking batteries is likely to be hazardous waste

under RCRA because it is likely to demonstrate the characteristic of corrosivity, and may contain lead and other metals.

- Neutralize acid spills and dispose of the resulting waste as hazardous if it still exhibits a characteristic of a hazardous waste.

- Avoid skin contact with leaking or damaged batteries.

Machine Shop Wastes. The major hazardous wastes from metal machining are waste cutting oils, spent machine coolant, and degreasing solvents. Scrap metal can also be a component of hazardous waste produced at a machine shop. Material substitution and recycling are the two best means to reduce the volume of these wastes.

The preferred method of reducing the amount of waste cutting oils and degreasing solvents is to substitute with water-soluble cutting oils. If non-water-soluble oils must be used, recycling waste cutting oil reduces the potential environmental impact. Machine coolant can be recycled, either by an outside recycler, or through a number of in-house systems. Coolant recycling is most easily implemented when a standardized type of coolant is used throughout the shop. Reuse and recycling of solvents also is easily achieved, although it is generally done by a permitted recycler. Most shops collect scrap metals from machining operations and sell these to metal recyclers. Metal chips which have been removed from the coolant by filtration can be included in the scrap metal collection. Wastes should be carefully segregated to facilitate reuse and recycling.

III.A.8. Fuel Use and Fueling Activities

Fuel is used to operate agricultural machinery, equipment, and vehicles that are used throughout almost every step of crop production, including preparing the site/soil, planting and tending the crops, applying nutrients and pesticides, irrigating and harvesting the crops, and post-harvesting activities. Agricultural machinery and vehicles are typically fueled using an aboveground fueling dispenser that is connected to an aboveground or underground fuel tank.

Potential Pollution Outputs and Environmental Impacts

Agricultural machinery and vehicles that use fuel most likely emit pollutants to the atmosphere. The activity of fueling itself can emit air

pollutants, and spills of fuel can cause water, soil and groundwater contamination. Underground fueling systems that are not monitored or maintained properly can leak into the surrounding soils and eventually contaminate groundwater.

Pollution Prevention/Waste Minimization Opportunities

Properly maintaining fuel tanks, lines, and fueling systems can substantially reduce the probability of accidental fuel spills or leaks. All leaking pipe joints, nozzle connections, and any damage to the fueling hose (e.g., kinks, crushing, breaks in the carcass, bulges, blistering, soft spots at the coupling, deep cracks or cuts, spots wet with fuel, or excessive wear) should be fixed immediately to reduce the amount of pollution to the environment. Spill and overflow protection devices can be installed to prevent fuel spills and secondary containment can be used to contain spills or leaks. Additional pollution prevention techniques for fueling include the following:

- Inspect fueling equipment daily to ensure that all components are in satisfactory condition. While refueling, check for leaks.
- If refueling occurs at night, make sure it is carried out in a well-lighted area.
- Never refuel during maintenance as it might provide a source of ignition to fuel vapors.
- Do not leave a fuel nozzle unattended during fueling or wedge or tie the nozzle trigger in the open position.
- Discourage topping off of fuel tanks.

III.A.9. Maintaining the Facility

Providing Drinking Water

As part of maintaining the physical site, an owner often is responsible for providing and maintaining a safe source of drinking water for those individuals who live or work at the site. Water provided from a surface water supply or groundwater supply may be considered a public water system and, as such, is subject to federal regulations. To be

A public water system is a system that receives water from a well, river, reservoir, or other sources, and serves piped water to at least 15 service connections or regularly serves an average of 25 people each day for at least 60 days.

subject to the Safe Drinking Water Act, the system must meet set criteria such that it is classified as one of the following water systems: community, non-transient non-community, or transient non-community. To ensure the drinking water source, whether surface or groundwater, is not contaminated, the regulations require the owner of the public water system to conduct periodic monitoring and analyses.

Potential Pollution Outputs and Environmental Impacts

Surface water supplies may become contaminated through runoff. Groundwater supplies may become contaminated through a variety of sources, including runoff and leaching, improperly grouted wellheads, improperly constructed or sited wellheads, or faulty onsite septic systems. Potential environmental impacts from contaminated drinking water include a wide variety of health effects for those who ingest it. Depending on the contaminant, the water may cause short-term illnesses and may also lead to long-term health effects.

Pollution Prevention/Waste Minimization Opportunities

The primary concern with drinking water is to ensure it does not become contaminated. The previous sections of this chapter discussed the pollution prevention methods associated with crop production that can help ensure that surface water or groundwater does not become contaminated, and thus result in contaminated drinking water.

Managing Equipment Containing PCBs

Facility maintenance includes managing equipment that may contain PCBs, such as generators, electrical transformers and their bushings, capacitors, reclosers, regulators, electric light ballasts, and oil switches. Facilities must ensure through activities related to the management of PCBs (e.g., inspections, proper storage) that human food or animal feed are not exposed to PCBs.

Potential Pollution Outputs and Environmental Impacts

The potential pollution outputs are spills or leaks of PCB-containing oil from this equipment and hazardous air emissions in the event of an electrical fire. These releases can result in air, water, and soil contamination. While the regulations do not establish a specific distance limit, any item containing PCBs is considered to pose an unacceptable exposure risk to food or feed if PCBs released in any form have the potential to reach/contaminate food or feed.

Pollution Prevention/Waste Minimization Opportunities

There are several techniques that can be used to prevent releases of PCBs to the environment and contamination of food or feed. These

include replacing the PCB-containing equipment; replacing the PCB-containing oil with oil that does not contain PCBs; providing secondary containment of the equipment so that spills cannot contaminate the soil or groundwater; and relocating the equipment to a location that does not present an exposure risk to food or feed. PCB-containing equipment should be inspected regularly for leaks and any deterioration that may cause an electrical fire.

Renovating and Demolishing Structures

Asbestos and lead-based paint may be present in structures that are being renovated or demolished. While EPA banned the use of many asbestos-containing materials in the 1970s, buildings built before this are likely to have asbestos-containing materials. Used as insulation and a fire retardant, asbestos and asbestos-containing materials can be found in a variety of building construction materials, including pipe and furnace insulation materials, asbestos shingles, millboard, textured paint and other coating materials, and floor tiles. It is also found in vehicle brake linings. Lead-based paint can typically be found on the interiors and exteriors of buildings constructed prior to 1978. This is because EPA banned the manufacture and use of lead-based paint and lead-based paint products in 1978.

Potential Pollution Outputs and Environmental Impacts

The renovation and demolition of structures can impact the environment as materials that may have previously been trapped within or on buildings become exposed to the environment. When encapsulated, asbestos fibers do not impact human health or the environment. However, during renovation or demolition, asbestos fibers may be released. If inhaled or ingested, asbestos fibers can cause respiratory damage.

Lead is a known carcinogen through any exposure pathway and may result in significant health effects. As with asbestos, lead-based paint that remains intact and is not chipping or otherwise deteriorating, does not present health problems. However, when it does become damaged, it should be properly removed, contained, and disposed of to prevent exposure. The activity of paint removal has the potential to impact human health and the environment as lead-containing fibers, dust, and paint chips are released. Paint chips and dust can cause indoor air contamination during renovation, and soil contamination from demolition or improper disposal. In addition, lead-based paint chips and dust, if ingested, can create severe, long-term health effects, especially for children.

Pollution Prevention/Waste Minimization Opportunities

The potential impact can be mitigated by assuring any asbestos is encapsulated within the building structure while the building is being used, and properly contained during construction and demolition.

III.B. Greenhouses and Nurseries: Operations, Impacts, and Pollution Prevention Opportunities

This section provides an overview of commonly employed operations and maintenance activities at greenhouses and nurseries. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the major sources pollution outputs and environmental impacts from producing greenhouse and nursery products. General pollution prevention and waste minimization opportunities are also discussed in the context of each operation.

Facilities that are engaged in greenhouse and nursery operations (e.g., horticulture), are responsible for growing and selling greenhouse and nursery products. Many of the activities related to horticulture production are quite similar to those necessary for production of crops. As a result, the material inputs, pollution outputs, and potential environmental impacts are very similar to those discussed throughout Section III.A.

While this section focuses on those activities for operations that fall under NAICS code 0114 (SIC code 018), many of these activities also take place under other parts of NAICS code 011 - Crop Production (SIC code 01). In contrast to food crops, horticultural production may include maintenance of plants and trees for two or more growing seasons. While food crops are harvested to be consumed, horticulture products are often sold live. Furthermore, horticulture production includes activities that take place both indoors and in the open air.

This section describes the following horticultural production activities:

- Preparing soil/growing media for horticulture crops
- Planting horticulture crops
- Applying nutrients to horticulture crops
- Applying pesticides and pest control for horticulture crops
- Irrigating horticulture crops
- Tending and harvesting horticulture crops
- Constructing and maintaining greenhouses
- Transporting products
- Maintaining and repairing equipment

- Fuel use and fueling equipment

Exhibit 21 presents material inputs and pollution outputs from each of these processes.

Activity	Raw Material Input	
Preparing soil/growing media	S Soil, peat, or other synthetic growing media S Lime	S Air emissions (e.g., dust) S Sediment, nutrient, and pesticides runoff from soil erosion
Planting	S Seeds, seedlings	S Air emissions (e.g., dust) S Sediment, nutrient, and pesticide runoff from soil erosion S Plants, branches, leaves, etc.
Applying nutrients	S Organic nutrients S Commercial nutrients S Water	S Runoff and leaching of unused or misapplied nutrients S Chemical air emissions
Applying pesticides and pest control	S Pesticides (including insecticides, rodenticides, fungicides, and herbicides)	S Runoff and leaching of unused or misapplied nutrients S Chemical air emissions
Irrigating (not including nutrient application)	S Water S Chemicals	S Runoff contaminated with sediments, salts, pesticides, and nutrients
Tending and harvesting		S Plant and tree clippings
Constructing and maintaining greenhouses	S Construction materials S Fuel for heating and cooling S Boiler chemicals	S Construction wastes S Air emissions S Storm water runoff from increased impervious area S Spills of boiler chemicals
Packaging, loading, and transporting horticulture crops	S Plastic, burlap or paper packaging materials	S Dead plants S Waste packaging materials

Exhibit 21. Greenhouse and Nursery Production Activities, Raw Material Inputs, and Pollution Outputs		
Activity	**Raw Material Input**	**Pollution Output**
Maintaining and repairing equipment	S Oil S Lubricating fluids S Fuel S Coolants S Solvents S Tires S Batteries S Equipment parts	S Used oil S Spent fluids S Spent batteries S Metal machining wastes S Spent organic solvents S Tires S Air, water, soil, and groundwater pollution resulting from spilled and/or spent fluids
Fuel use and fueling activities	S Fuel	S Air emissions from machinery S Air, water, soil, and groundwater pollution resulting from spills

III.B.1. Preparing Soil/Growing Media for Horticulture Crops

Prior to planting, the soil or growing media[3] must be prepared for growing horticulture crops. For horticulture crops grown outdoors, soil preparation generally involves tilling and the application of nutrients, primarily commercial fertilizer. Tilling aerates the soil, allows seedlings to be placed in the soil, and helps roots take hold of the soil. It also improves drainage and allows for better assimilation of nutrients (i.e., fertilizers) and pesticides into the soil. For greenhouse crops, proper soil or media preparation is key for fostering plant growth. Due to the relatively shallow depth and limited volume of greenhouse containers, soil must be amended to provide the physical and chemical properties necessary for plant growth.[4] Materials are added to the soil that promote improved aeration, drainage, and water holding capacity. These materials can include peat and peat-like materials, wood residues, rice hulls, sand, vermiculite, calcined clays, expanded polystyrene, urea formaldehydes, and bagasse (a waste byproduct of the sugar industry that is often composted to promote aeration). In addition, soil pH is often

[3] Note that many indoor growing operations use non-soil media consisting of peat moss, compost, lime, and other material, rather than soil in order to provide a more porous growth environment in a relatively small volume container.

[4] *Texas Greenhouse Management Handbook,* Dr. Don Wilkerson, Texas Agricultural Extension Service, http://aggie-horticulture.tamu.edu/greenhouse/guides/green/green.html.

adjusted by adding ground limestone, hydrated lime, or dolomitic lime to suit the plants being grown.[5]

Potential Pollution Outputs and Environmental Impacts

The major environmental impacts of soil/growing media preparation in horticulture operations is runoff that carries pollutants (e.g., soils/growing media, nutrients, pH adjusting agents, pesticides) to groundwater or surface waters.

For outdoor operations, the primary pollution output is runoff contaminated with pollutants (e.g., sediments, nutrients, and pesticides) caused by soil erosion. Soil erosion causes damage both onsite and offsite at horticulture operations. Onsite erosion can reduce the productivity of the operation and increase the need for fertilizer and other inputs. Pollutants (e.g., sediments, nutrients, and pesticides) that are transported offsite by runoff may be deposited in surface waters, leading to reduced oxygen content, increased algae growth, and overall degradation of water quality.

Indoor operations can also be sources of water pollution. Runoff that comes in contact with spills of soil/soil media, improperly managed outdoor bulk soil/media piles, or discharges of floor washdown water can transport sediments and other pollutants to surface waters. Spilled or excessively applied lime also has the potential to contaminate groundwater or surface waters.

Pollution Prevention/Waste Minimization Opportunities

When preparing soil for outdoor operations, runoff can be reduced by planting and maintaining buffer strips of grass and sod. These strips can slow runoff and trap sediment, reducing soil loss and potentially preventing water contamination. Horticulture operations that maintain grass strips between rows of plants or trees have been shown to maintain 30 percent to 50 percent more soil than those that maintain only bare soil.[6]

[5] *Effect of pH on Pesticide Stability and Efficacy,* Winand K. Hock, Penn State University, http://pmep.cce.cornell.edu/facts-slides-self/facts/gen-peapp-ph.html.

[6] *Best Management Practices for Field Production of Nursery Stock*, North Carolina State University Biological and Agricultural Engineering Extension Service, http://www.bae.ncsu.edu/programs/extension/ag-env/nursery/.

Unnecessary application of materials that could potentially leach into and pollute nearby water sources can be prevented through frequent soil testing prior to application. Spills can be prevented by assuring the integrity of the containers in which the materials are kept. Containers should be routinely repaired and replaced if perforated.

III.B.2. Planting Horticulture Crops

Horticulture crops are planted after the soil/soil media is prepared. Planting involves the placement of seeds or seedlings into the soil/soil media. Planting is typically done by hand for greenhouse operations, while planting may be done either by hand or mechanically for nursery operations.

Potential Pollution Outputs and Environmental Impacts

The major inputs in planting horticulture crops are the seeds and energy used to plant them. The pollutant outputs include air emissions from any planting equipment.

Pollution Prevention/Waste Minimization Opportunities

Pollution prevention opportunities during the planting process for horticulture operations are similar to those discussed in Section III.A.2.

III.B.3. Applying Nutrients to Horticulture Crops

During all phases of the crop production process, nutrients (e.g., fertilizer, manure, biosolids) can be applied to horticulture crops. Nutrients enhance crop growth by providing essential nitrogen, phosphorus, potassium, and micro-nutrients. Nutrients can be applied directly to the plant or soil surface, incorporated into the soil, or applied with irrigation water through chemigation.

Most greenhouse operations use liquid fertilizers, supplemented by granular or slow release fertilizers which are added to the growing medium. While the frequency of fertilizer application may vary, many operations continuously fertilize through irrigation systems. For outdoor operations, nutrient application is often more mechanically intensive, requiring coverage of large areas. Nearly all acres planted are treated with one or more types of nutrients (e.g., fertilizers, manure, or biosolids). Depending on the timing of the seed planting, the application may occur simultaneously.

For outdoor operations, fertilizers may be applied in solid, liquid, or gas form. Depending on the state of the product, nutrients may be applied using

specialized trucks to apply dry product, tractors to pull sprayer equipment for liquids, and pressurized tanks to apply anhydrous ammonia. Techniques used to apply fertilizer include the following:

- *Band placement* is used to locate the fertilizer in an optimum position relative to the seed. This minimizes salt injury to the developing roots.

- *Broadcast application* refers to the practice of distributing the product uniformly over the soil surface. Tractors, airplanes and helicopters are used to broadcast fertilizers.

- *Injection* refers to the application of anhydrous ammonia. At normal pressure, anhydrous ammonia (NH_3) is a gas. For application as a fertilizer, it is pressurized to form a liquid. Because it is a volatile liquid, it is incorporated into the soil as a liquid under pressure to a depth of 15 to 25 cm. In the soil, NH_3 is converted to NH_4^+, which is stable. Gaseous ammonia is lost if soil pH increases much above 7, or as moisture fluctuates from field capacity.

- *Addition of fertilizer to irrigation water* (known as fertigation), is usually part of a drip irrigation system that can apply water and fertilizer to a precise predetermined location.

- *Manure and biosolids* may be applied to the soil surface as a solid from a tractor-pulled box-type manure spreader as it makes passes across the field. Slurry manure and biosolids are generally applied to the soil surface by tractor-pulled or truck flail spreaders or subsurface by tractor or truck injection equipment. Liquid manure may be surface irrigated or subsurface injected. Manure and biosolid solids and slurries may be mechanically incorporated into the soil following application.

Potential Pollution Outputs and Environmental Impacts

There are several potential pollution outputs and environmental impacts from nutrient application and spills including runoff and leaching of improperly or excessively applied nutrients which can contaminate surface water and groundwater; air emissions; and increases in the amount of soluble salts in soils. Excessive amounts of soluble salts in the soil can prevent or delay seed germination, kill or seriously retard plant growth, and possibly render soils and groundwater unusable.

The degree of environmental impacts depends on the application method. The surface application of fertilizer, manure, or biosolids is more likely to result in runoff than injection. Non-composted surface-applied manure will volatilize and release ammonia to the air. Spills of nutrients may also negatively impact the environment since they will be concentrated in one specific area.

Pollution Prevention/Waste Minimization Opportunities

There are several pollution prevention techniques that can be used to reduce pollution and impacts from nutrient application. These include:

- Application methods that prevent runoff (e.g., application by injection).
- Restricting application in close proximity to surface waters.
- Applying nutrients at agronomic rates to crops/cropland.
- Managing the site to eliminate erosion or reduce the runoff potential.
- Developing and implementing **nutrient management plans**. The primary purpose of nutrient management is to achieve the level of nutrients (e.g., nitrogen and phosphorus) required to grow the planned crop by balancing the nutrients that are already in the soil with those from other sources (e.g., manure, biosolids, commercial fertilizers) that will be applied. At a minimum, nutrient management can help prevent the application of nutrients at rates that will exceed the capacity of the soil and the planned crops to assimilate nutrients and prevent pollution. More information on nutrient management plans is presented in Section III.A.3.

III.B.4. Applying Pesticides and Pest Control for Horticulture Crops

The pesticides commonly used in horticulture operations include insecticides, fungicides, and herbicides. For large nursery operations, pesticides are often applied through liquid spraying. As described in Section III.A.4., liquid spraying may be conducted by aircraft, tractor spray rigs, or blasters.

- Aerial methods are the most common spray applications, with about two-thirds of all insecticides and fungicides applied in this manner. Trees and shrubs may be aerially treated several times per season with insecticides, fungicides, and protectant oils. Helicopters are often used

because the turbulence from the main rotor tends to push the pesticides down toward the plant.

- Tractor spray rigs provide an advantage where horticulture crops are grown in rows because planting, fertilizing and spraying can be accomplished in one pass through the field.

- Blasters can be used for applying insecticides and fungicides to trees.

Potential Pollution Outputs and Environmental Impacts

The potential environmental impacts from pesticide application are runoff or leaching to surface water or groundwater, spills to surface waters, potential human exposure, and soil contamination that could leave land unproductive. These environmental impacts may all occur if pesticides are not applied according to the label directions. Impacts from pesticide application to horticulture crops are similar to those discussed in Section III.A.4.

Pollution Prevention/Waste Minimization Opportunities

As discussed previously in Section III.A.4, the best way to prevent environmental impacts from pesticide use is follow label directions for application and prevent or minimize their use wherever possible. Pesticide use accounts for a significant portion of horticulture production costs. By reducing their use, horticulture operations cannot only reduce production costs, but also reduce environmental impacts from their operations. Pesticide use can be minimized by using integrated pest management approaches, new technologies, efficient application methods, controls, and basic preventive measures. Pollution prevention opportunities for reducing or minimizing impacts from application of pesticides are discussed in Section III.A.4.

III.B.5. Irrigating Horticulture Crops

Irrigation transports water to horticulture crops to nourish the crops, ease the shock to the plants following transplant, and keep the crops cool in arid or excessive heat conditions. There are many different irrigation systems, all of which are designed to move water from its source to where it can be used for crop production. Irrigation water is obtained from onsite groundwater and surface water sources, as well as offsite sources such as rivers, pipelines, canals and aqueducts that are operated by irrigation districts and private water companies.

All greenhouse crops are irrigated on a regular basis (since they are enclosed and do not receive water from rainfall events). Water is generally applied to the upper surface of the soil/growing media by using overhead sprinklers, drip or trickle irrigation systems, hand-held hoses, or a combination of methods. The advantage of drip or trickle systems is that they minimize water use, leaching of nutrients in the growth media, and reduce the probability of root rot in excessively moist soil. Overhead sprinklers and hand water irrigation methods are often less expensive to implement, but use more water per plant.[7]

Potential Pollution Outputs and Environmental Impacts

For indoor operations, the primary pollution outputs are wastewater and runoff that contains nutrients and pesticides. For outdoor horticulture operations, the pollution outputs from irrigation include runoff and leaching of nutrients and pesticides, salinization, and groundwater depletion. The impacts of pollutants (e.g., nutrients, pesticides, and sediments) from irrigation-induced runoff are similar to those discussed in Section III.A.5.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention opportunity for irrigation is the use of irrigation methods which efficiently apply water, thereby reducing water use and the potential for runoff. One efficient application method is drip irrigation. Drip irrigation gradually applies water directly to the soil surface over extended periods of time (i.e., 1, 2, or 5 gallons per hour), resulting in less water loss due to evaporation or runoff. If nutrients are applied using drip irrigation, the amount of fertilizer used can also be reduced if the nutrients are applied at the utilization rate of the plant. In addition to the environmental benefits, drip irrigation tends to cause roots to concentrate within the limited wetted soil area, thus creating a more concentrated root ball. More concentrated root balls make the plants easier to ship and increase their ability to survive through the sale and planting process.[8] Section III.A.5 describes other potential pollution prevention opportunities associated with irrigation.

[7] *Texas Greenhouse Management Handbook,* Dr. Don Wilkerson, Texas Agricultural Extension Service, http://aggie-horticulture.tamu.edu/greenhouse/guides/green/green.html.

[8] *Best Management Practices for Field Production of Nursery Stock*, North Carolina State University Biological and Agricultural Engineering Extension Service, http://www.bae.ncsu.edu/programs/extension/ag-env/nursery/.

III.B.6. Tending and Harvesting Horticulture Crops

Horticulture crops must be maintained from planting through the point of sale. Each plant may be tended for one or several growing seasons. Tending horticulture crops involves applying water, nutrients, and pesticides; transplanting crops from small to larger pots or from pots to outside areas; and pruning trees and shrubs to enhance plant health and make them more aesthetically pleasing.

Harvesting of horticulture crops involves digging, cutting, or other methods of safely removing product from the ground, stalks, vines, or trees. Harvesting must be done with care to protect the plant and assure that it remains alive through the point of sale. For flowers, small plants, and greenhouse-grown vegetables, harvesting is generally done manually. For larger trees and shrubs, harvesting may be done by hand or by machine.

Potential Pollution Outputs and Environmental Impacts

The primary pollution outputs from tending and harvesting horticulture crops are plant clippings (e.g., branches, leaves, and flowers) that have been removed during the tending/pruning activities.

Pollution Prevention/Waste Minimization Opportunities

There are several pollution prevention and waste minimization opportunities for tending and harvesting activities. These include:

- *Maintaining harvesting machinery and vehicles*. Section III.A.7. *Maintaining and Repairing Agricultural Machinery and Vehicles* discusses various methods of keeping an environmentally responsible farm vehicle.

- *Composting plant clippings*. Plant clippings can be composted, while tree clippings can be used as drying material to compost the plant clippings. Tree clippings can also be ground as mulch and reused in the fields or greenhouse. By placing wood waste under covered structures or tarps, operators can also reduce the decomposition and leaching from wood waste piles.[9]

[9] *Environmental Guidelines for Greenhouse Growers - Site Planning*, British Columbia Ministry of Agriculture and Food, 1998, http://www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/greenhse/grnhse.htm.

III.B.7. Constructing and Maintaining Greenhouses

Greenhouse construction and design can influence how effectively horticulture crops grow, as well as the operation's ability to minimize environmental impacts. Greenhouse construction includes building the structure and ensuring that it meets the operational requirements of the horticulture operation.

Greenhouse maintenance involves maintaining the structural integrity as well as the appropriate climate conditions. Activities may include operating and maintaining boilers that provide heat during cold weather; operating fans to keep crops and workers cool during warm weather; and general maintenance of the greenhouse itself.

Potential Pollution Outputs and Environmental Impacts

The potential pollutant outputs from greenhouse construction include increased potential for storm water runoff during construction; air emissions from construction equipment; and construction wastes primarily consisting of packaging materials, steel or aluminum parts, and waste concrete. Boilers used for heating greenhouse can produce air emissions and potential spills of boiler chemicals can impact the environment.

Pollution Prevention/Waste Minimization Opportunities

Many pollution prevention opportunities begin at the design and construction stage. Pollution prevention opportunities in greenhouse design include:

- Locating storage facilities for fuel, wood waste, fertilizer, or pesticides far away and contained from any watercourse.
- Locating well water sites on the highest elevation on the property and as far as possible from areas where fertilizer, pesticides, and petroleum products are stored or handled.
- Designing the greenhouse so that it can accommodate efficient drip irrigation systems.
- Planning facilities that can separate and disinfect irrigation or wash water so that the water can be reused.
- Installing closed systems that minimize or prevent leaching from irrigation systems.

- Constructing foundations and floors that permit recovery of leachate, such as lined soil zones and concrete floors.
- Selecting efficient watering systems.
- For outdoor areas, using well-drained gravel keeping impervious pavement to a minimum.[10]

Implementing these activities in the design and construction stage helps facilitate their implementation throughout the production process.

III.B.8. Packaging, Loading, and Transporting Products

Horticulture crops must be packaged, loaded, and transported by truck or rail to their destinations. Packaging materials may include plastic, burlap, or paper.

Potential Pollution Outputs and Environmental Impacts

The primary pollution outputs include damaged or dead plants and discarded packaging materials, all of which may be managed as solid waste. Hydraulic lifts or conveyors used in the loading process may leak oil, resulting in soil contamination.

Pollution Prevention/Waste Minimization Opportunities

Pollution prevention opportunities for packaging include reducing the volume of packaging used and recycling any waste packaging materials when possible. Pollution prevention ideas for reducing emissions from transport vehicles are similar to those discussed in Section III.A.7.

III.B.9. Maintaining and Repairing Machinery and Vehicles at Greenhouses/Nurseries

Horticulture operations operate and maintain heavy equipment that is used for preparing soil, maintaining the crops, and transporting products for sale. Day-to-day maintenance and repair activities keep machinery and vehicles safe and reliable. Maintenance activities include oil and filter changes, battery replacement, and repairs including metal machining.

[10] *Environmental Guidelines for Greenhouse Growers - Site Planning*, British Columbia Ministry of Agriculture and Food, 1998, http://www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/greenhse/grnhse.htm.

Potential Pollution Outputs and Environmental Impacts

The wastes from maintenance and repair activities can include used oil, spent fluids, spent batteries, metal machining wastes, spent organic solvents, and tires. These wastes have the potential to be released to the environment if not handled properly, stored in secure areas with secondary containment, protected from exposure to weather, and properly disposed of. If released to the environment, the impact of these releases can be contamination of surface waters, groundwater, and soils, as well as toxic releases to the atmosphere. Groundwater pollution can also result from discharges of wastes to Class V wells.

Pollution Prevention/Waste Minimization Opportunities

Preventive maintenance programs can minimize waste generation, increase equipment life, and minimize the probability of significant impacts and accidents. Where the wastes cannot be eliminated, safe handling and recycling can minimize environmental impacts. Pollution prevention/waste minimization opportunities for these wastes are similar to those discussed previously in Section III.A.7.

III.B.10. Fuel Use and Fueling Activities at Greenhouses/Nurseries

Fuel is used to operate agricultural machinery, equipment, and vehicles that are used for horticulture crop production, including preparing the site/soil, planting crops, applying nutrients and pesticides, irrigating, and post-harvesting activities. Agricultural machinery and vehicles are typically fueled using an aboveground fueling dispenser that is connected to an aboveground or underground fuel tank.

Potential Pollution Outputs and Environmental Impacts

Agricultural machinery and vehicles that use fuel most likely emit pollutants to the atmosphere. The activity of fueling itself can emit air pollutants, and spills of fuel can cause water, soil and groundwater contamination. Underground fueling systems that are not monitored or maintained properly can leak into the surrounding soils and eventually contaminate groundwater.

Pollution Prevention/Waste Minimization Opportunities

Properly maintaining fuel tanks, lines, and fueling systems can substantially reduce the probability of accidental fuel spills or leaks. All leaking pipe joints, nozzle connections, and any damage to the fueling hose (e.g., kinks, crushing, breaks in the carcass, bulges, blistering, soft spots at the coupling, deep cracks or cuts, spots wet with fuel, or excessive wear) should be fixed immediately to reduce

the amount of pollution to the environment. Spill and overflow protection devices can be installed to prevent fuel spills and secondary containment can be used to contain spills or leaks. Additional pollution prevention techniques to prevent fuel spills and methods to more efficiently refuel are discussed in Section III.A.8.

III.C. Forestry Production Industry: Operations, Impacts, and Pollution Prevention Opportunities

Nearly 500 million acres of forest land are managed for the production of timber in the United States. This section provides an overview of commonly employed operations and maintenance activities in the forestry industry. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the major sources of environmental impacts from forestry. It also presents an overview of pollution prevention and waste minimization opportunities within the industry.

Summary of General Potential Pollution Outputs and Environmental Impacts for the Forestry Production Industry

EPA's National Summary of Water Quality Conditions (1998) lists silviculture nonpoint source pollution as contributing to 7 percent of impaired river miles, 7 percent of impaired acres of lakes, and 3 percent of impaired square miles of estuaries. Forestry activities can contribute to nonpoint source pollution and water quality degradation through erosion, removal of streamside vegetation, destruction of habitat, and the use of pesticides and nutrients, primarily commercial fertilizers. Habitat destruction can impact various animals, including endangered species such as the spotted owl. Eroded forest soils potentially are carried to surface waters where sedimentation occurs and stream life is negatively impacted. The removal of streamside vegetation increases the potential for erosion and also eliminates shading of the waterbody. Turbidity from erosion and reduced shade result in higher water temperatures and lower dissolved oxygen concentration. Pesticides and fertilizers can be carried in runoff to waterbodies affecting water quality.

Summary of General Pollution Prevention/Waste Minimization Opportunities for the Forestry Production Industry

Best management practices applied to forestry operations can be classified as 1) prevention measures as part of planning, policy and management; and 2) reduction measures applied to the land as an integral part of the silvicultural activity. Prevention through management decision involves the incorporation

of environmental protection into organizational policy and in the planning, design and scheduling of forestry activities. At this stage, location and design of logging access roads, intermediate activities, harvesting methods, and reforestation decisions should be made to prevent or minimize the aggravation of inherent pollution hazards.

The reduction measures to control erosion and sediment runoff generally utilize some physical, biological, or chemical method or technique. Reduction measures modify and reduce the unavoidable disturbances caused by an activity, for example, revegetation of cleared areas, mulching of roadcuts and fills, and removal of debris from watercourses. Reduction measures also include the construction of berms, rip-rapping, baffles, drop structures, catch basins, cross-drains, and slope stabilization on road sites. Because of the widespread nature of sediment runoff, erosion control measures must be a principal thrust of the water quality management program on each forestry management unit.

In areas where nutrients, pesticides, and other chemicals cause particular problems on surface waters or groundwater, further control measures may be necessary. These measures could relate to the application (timing methods and amount), utilization, and management of fertilizers, pesticides, and fire retardant chemicals. Particular attention should be taken to keep chemicals away from streams. Care must be exercised to ensure that thermal problems are not created in streams by excessive removal of shade canopy. Attention to proper forest management, engineering, and harvesting principles can substantially reduce pollution attributed to forestry.

The following considerations should be part of the pre-harvest planning stage: threatened and endangered species and sensitive habitats, wetland areas, streamside management area/width, cumulative effects analysis, timing of operation (i.e., to avoid moisture), and identification of landslide potential and other high risk areas.

Operations of the Forestry Production Industry

This section describes the following forestry production activities:

- Road construction and use
- Timber harvesting
- Forest Regeneration
- Site preparation
- Prescribed burning
- Application of chemicals

Exhibit 22 presents raw material inputs and pollution outputs from each of these forestry production activities.

Exhibit 22. Forestry Production Activities, Raw Material Inputs, and Pollution Outputs

Activity	Raw Material Input	Pollution Output
Road construction and use	S Fuel and oil used in construction equipment	S Sediment in runoff from soil erosion S Air emissions
Timber harvesting	S Fuel and oil used in harvesting, chipping, loading, and hauling equipment	S Sediment and organic debris in runoff from soil erosion S Thermal pollution S On-site leaks (i.e., hydraulic fluid) S Air emissions
Forest regeneration	S Fuel used in planting equipment S Commercial fertilizers	S Sediment in runoff from soil erosion S Nutrient in runoff from fertilizer application S Air emissions
Site preparation	S Fuel and oil used in mechanical equipment S Chemical herbicides	S Sediment in runoff from soil erosion S Chemicals in runoff from herbicide application S Air emissions
Prescribed burning	S Fuel to start fire	S Sediment in runoff from soil erosion S Air emissions (smoke)
Application of chemicals	S Fertilizers S Pesticides S Water S Fuel used in application equipment	S Chemical air emissions S Runoff contaminated with chemicals

III.C.1. Road Construction and Use

Building the road system to allow for harvesting involves clearing the roadway of trees, grading soil, placing culverts for stream crossings, construction, and surfacing. Following road construction, the forest becomes accessible for the

logger to fall the trees and transport them to a landing where they will then be loaded and transported to the mill.

There are several types of roads used in timber harvesting. The cheapest and easiest road is the skid trail which is usually nothing more than a dirt path used by the skidders to get the trees to the landing area. Skid trails must be located outside of the Streamside Management Zone (SMZ) and must use a bridge or culvert of acceptable design to cross perennial or intermittent streams. The road from the landing to the main road is usually better than a skid trail because it must support the trucks that haul the wood to the mill. Some wood product companies build roads designed to last for many years. However, these type of roads are too expensive for most landowners to construct.

Rolling dips, water bars, cross-drains, water turnouts, and culverts are used to control runoff and erosion, and allow vehicles to cross intermittent or perennial streams.

Abandonment of roads, watercourse crossings, and landings must be planned and conducted in a manner that provides for permanent maintenance-free drainage to soil resources; minimizes concentration of runoff, soil erosion, and slope instability; prevents unnecessary damage to soil resources; promotes regeneration and protects the quality and beneficial uses of water.

Potential Pollution Outputs and Environmental Impacts

The primary pollution outputs during road construction and use may include air emissions from road construction equipment and machinery used for harvesting and soil erosion. Roads are considered to be the major source of erosion from forested lands, contributing up to 90 percent of the total sediment production from forestry operations. Erosion potential from roads is accelerated by increasing slope gradients on cut-and-fill slopes, intercepting subsurface water flow, and concentrating overland flow on the road surface and in channels. Roads with steep gradients, deep cut-and-fill sections, poor drainage, erodible soils, and road-stream crossings contribute to most of this sediment load, with road-stream crossings being the most frequent sources of erosion and sediment. Soil loss tends to be greatest during and immediately after road construction because of the unstabilized road bed and disturbance by passage of heavy trucks and equipment.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in road construction and use are designed to reduce erosion of soil and minimize delivery of

sediment to surface waters. Proper road design and construction can prevent road fill and road backslope failure, which can result in mass movements and severe sedimentation. Proper road drainage prevents concentration of water on road surfaces, thereby preventing road saturation that can lead to rutting, road slumping, and channel washout. Proper road drainage during logging operations is especially important because that is the time when erosion is greatly accelerated by continuous road use.

Surface protection of the roadbed and cut-and-fill slopes can:

- Minimize soil losses during storms.
- Reduce frost heave erosion production.
- Restrain downslope movement of soil slumps.
- Minimize erosion from softened roadbeds.

Although there are many commonly practiced techniques to minimize erosion during the construction process, the most meaningful are related to how well the work is planned, scheduled, and controlled by the road builder and those responsible for determining that work satisfies design requirements and land management resource objectives. Most erosion from road construction occurs within a few years of disturbance. Therefore, erosion control practices that provide immediate results (such as mulching or hay bales) should be applied as soon as possible to minimize potential erosion.

Drainage of the road prism, road fills in stream channels, and road fills on steep slopes are the elements of greatest concern in road management. Roads used for active timber hauling usually require the most maintenance, and mainline roads typically require more maintenance than spur roads. Use of roads during wet or thaw periods can result in a badly rutted surface, impaired drainage, and excessive sediment leading to waterbodies. Inactive roads, not being used for timber hauling, are often overlooked and receive little maintenance.

The following pollution prevention practices can be used for road construction and use:

- Follow the design developed during preharvest planning to minimize erosion by properly timing and limiting ground disturbance operations.

- Design skid trail grades to be 15 percent or less. Do not locate and construct roads with fills on slopes greater than 60 percent.

- Avoid construction during fish egg incubation periods on streams with important spawning areas.

- Compact the road base at the proper moisture content, surfacing, and grading to give the designed road surface drainage shaping. Compact the fill to minimize erosion and ensure road stability.

- Use straw bales, straw mulch, grass-seeding, hydromulch, and other erosion control and revegetation techniques to complete the construction project. These methods are used to protect freshly disturbed soils until vegetation can be established.

- Use turnouts, wing ditches, and dips to disperse runoff and reduce road surface drainage from flowing directly into watercourses.

- Install surface drainage controls to remove storm water from the roadbed before the flow gains enough volume and velocity to erode the surface. Route discharge from drainage structures onto the forest floor so that water will disperse and infiltrate.

- Install appropriate sediment control structures to trap suspended sediment transported by runoff and prevent its discharge into the aquatic environment.

- Revegetate or stabilize disturbed areas, especially at stream crossings.

- Protect access points to the site that lead from a paved public right-of-way with stone, wood chips, corduroy logs, wooden mats, or other material to prevent soil or mud from being tracked onto the paved road.

- Construct bridges and install culverts during periods when streamflow is low. Excavation for a bridge or a large culvert

should not be performed in flowing water. The water should be diverted around the work site during construction with a cofferdam or stream diversion.

- When soil moisture conditions are excessive, promptly suspend earthwork operations and take measures to weatherproof the partially completed work.

- Locate burn bays away from water and drainage courses.

- Maintain road surfaces by mowing, patching, or resurfacing as necessary. Clear road inlet and outlet ditches, catch basins, and culverts of obstructions. Blade and reshape the road surface to conserve existing surface material to allow normal surface runoff.

III.C.2. Timber Harvesting

Timber harvesting includes felling trees, preparing them by limbing, cutting them into desired lengths, and moving them to a central, accessible location for transport out of the forested area. The timber is removed (skidded or yarded) to a temporary storage site or landing by one of three basic methods: tractor/skidder (on skid trails), groundlead or highlead cable, or various skyline cable methods. Balloons and helicopters are also used to a limited extent in some areas.

The most common methods of harvesting in the United States are clearcutting, shelterwood, selection, and partial cutting.

- *Clearcutting* is the harvesting of all trees in an area in one cut to create a new even-aged stand. The area harvested is large enough to create an open condition. Economically, clearcutting is most efficient for the logger because all trees are removed, and the feller and skidder operator are not continually confronted with avoiding trees spared from harvest. However, because of the large volumes of material per unit area removed during clearcutting, more trips are required by the skidder, causing the greatest disturbance to the forest litter and underlying forest soil of all harvesting systems.

- *In shelterwood harvesting*, a mature stand is removed in a series of cuts. Regeneration of a new stand occurs under the cover of a partial forest canopy. The final harvest cut removes the sheltering canopy and

permits the new existing stand to develop in the open as an even-aged stand.

- *Selection harvesting* involves the removal of mature or immature trees either alone or in groups at somewhat regular time intervals from a forest stand. The objective of this harvesting system is the development and maintenance of an uneven-aged stand with trees of different ages or sizes intermingled singly or in groups. Individual (single) tree selection involves the removal of individual trees, while group selection may remove several adjacent trees covering a small fraction of an acre or larger numbers of trees covering areas as large as one or two acres. Group selection is distinguished from clearcutting in that the intent of group selection is ultimately to create a balance of age or size classes in a mosaic of small contiguous groups throughout the forest stand.

Potential Pollution Outputs and Environmental Impacts

The most detrimental effects of harvesting, which include soil disturbance, soil compaction, and direct disturbance of stream channels, are related to the movement of vehicles and machinery in the forest area, and the skidding and loading of trees or logs. These effects can be enhanced or minimized depending on logging operation planning, soil and cover type, slope, and the construction and use of haul roads, skid trails, and landings for access to and movement of logs. Thus, harvesting method used directly affects the amount of erosion, including the amount of sediment and organic debris that are transported into streams from the forest floor.

Harvesting can also increase stream water temperatures (i.e., thermal pollution) due to the removal of the canopy over streams, with the greatest potential impacts occurring in small streams. Temperature is a significant aspect of water quality. In some cases, it may strongly influence dissolved oxygen concentrations and bacterial populations in streams.

As with all harvesting methods, clearcutting can cause irreversible adverse impacts to the environment and can destroy an area's ecological integrity. These impacts include:

- The removal of forest canopy, which destroys the habitat for many rainforest-dependent insects and bacteria.

- The elimination of fish and wildlife species due to soil erosion and habitat loss.

- The destruction of buffer zones which reduce the severity of flooding by absorbing and holding water.

- The removal of forest carbon sinks, leading to global warming through the increased human-induced and natural carbon dioxide build-up in the atmosphere.

- The destruction of aesthetic values and recreational opportunities.

- Increased streamflow from removal of vegetation (resulting in reduction in transpiration and evaporation functions), fish passage barriers (i.e., improperly placed culverts), and cumulative effects within the watershed.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in timber harvesting are designed to minimize sedimentation resulting from the siting and operation of timber harvesting, and to manage petroleum products properly. Logging practices that protect water quality and soil productivity can reduce total mileage of roads and skid trails, lower equipment maintenance costs, and provide better road protection and lower road maintenance. Careful logging can disturb soil surfaces as little as 8 percent, while careless logging practices can disturb soils as much as 40 percent. Higher bulk densities and lower porosity of skid road soils due to compaction by rubber-tired skidders result in reduced soil infiltration capacity and corresponding increases in runoff and erosion.

Locating landings for both groundskidding and cable yarding harvesting systems according to preharvest planning minimizes erosion and sediment delivery to surface waters. However, final siting of landings may need to be adjusted in the field based on site characteristics.

Landings and loading decks can become very compacted and puddled and are therefore a source of runoff and erosion. Practices that prevent or disperse runoff from these areas before the runoff reaches watercourses will minimize sediment delivery to surface waters. Also, any chemicals or petroleum products spilled in harvest areas can be

highly mobile, adversely affecting the water quality of nearby surface waters. Appropriate spill prevention and containment procedures are therefore necessary to prevent petroleum products from entering surface waters. Designation of appropriate areas for petroleum storage will also minimize water quality impacts due to spills or leakage.

The following pollution prevention practices can be used during timber harvesting operations.

Harvesting Practices

- Harvest trees so that they fall away from watercourses, whenever possible, keeping logging debris from the channel, except where debris placement is specifically prescribed for fish or wildlife habitat.

- Any tree accidentally dropped in a waterway should be immediately removed.

Practices for Landings

- Landings should be no larger than necessary to safely and efficiently store logs and load trucks.

- The slope of landing fills should not exceed 40 percent, and woody or organic debris should not be incorporated into fills.

- If landings are to be used during wet periods, protect the surface with a suitable material such as wooden matting or gravel surfacing.

- Install drainage structures for the landings such as water bars, culverts, and ditches to avoid sedimentation. Disperse landing drainage over sideslopes. Provide filtration or settling if water is concentrated in a ditch.

- Upon completion of harvest, clean up landing, regrade, and revegetate.

- Locate landings for cable yarding where slope profiles provide favorable deflection conditions so that the yarding equipment used does not cause yarding corridor gouge or soil plowing, which concentrates drainage or causes slope instability.

Groundskidding Practices

- Skid uphill to log landings whenever possible. Skid with ends of logs raised to reduce rutting and gouging.
- Skid perpendicular to the slope (along the contour), and avoid skidding on slopes greater than 40 percent.
- Avoid skid trail layouts that concentrate runoff into draws, ephemeral drainages, or watercourses.
- Suspend groundskidding during wet periods, when excessive rutting and churning of the soil begins, or when runoff from skid trails is turbid and no longer infiltrates within a short distance from the skid trail. Further limitation of groundskidding of logs, or use of cable yarding, may be needed on slopes where there are sensitive soils and/or during wet periods.
- Retire skid trails by installing water bars or other erosion control and drainage devices, removing culverts, and revegetating.

Cable Yarding Practices

- Use cabling systems or other systems when groundskidding would expose excess mineral soil and induce erosion and sedimentation.
- Avoid cable yarding in or across watercourses.
- Yard logs uphill rather than downhill.

Petroleum Management Practices

- Service equipment where spilled fuel and oil cannot reach watercourses, and drain all petroleum products and radiator water into containers. Dispose of wastes and containers in accordance with proper waste disposal procedures. Waste oil, filters, grease cartridges, and other petroleum-contaminated materials should not be left as refuse in the forest.

- Take precautions to prevent leakage and spills. Fuel trucks and pickup-mounted fuel tanks must not have leaks.
- Develop a spill contingency plan that provides for immediate spill containment and cleanup, and notification of proper authorities.

III.C.3. Site Preparation

Site preparation is a management activity designed to increase productivity of a tract by controlling competing vegetation and debris that could slow seedling growth. It includes removal or deadening of unwanted vegetation prior to planting trees. Site preparation is accomplished by conducting prescribed burning, using herbicides, or disking (or otherwise altering) the soil.

Potential Pollution Outputs and Environmental Impacts

The pollution outputs may include air emissions from the machinery used, soil erosion during and after site preparation, and chemicals in runoff. Mechanical site preparation by large tractors that shear, disk, drum-chop, or root-rake a site may result in considerable soil disturbance over large areas and has a high potential to degrade water quality. Site preparation techniques that result in the removal of vegetation and litter cover, soil compaction, exposure or disturbance of the mineral soil, and increased storm flows due to decreased infiltration and percolation, can contribute to increases in stream sediment loads. However, erosion rates decrease over time as vegetative cover grows back. Prescribed burning and herbicides are other methods used to prepare sites that may also have potential negative effects on water quality.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in site preparation are designed to minimize sediment runoff caused by soil-disturbing machinery and chemicals in runoff from herbicide applications.

Leaving the forest floor litter layer intact during site preparation operations for regeneration minimizes mineral soil disturbance and detachment, thereby minimizing erosion and sedimentation. Maintenance of an unbroken litter layer prevents raindrop detachment, maintains infiltration, and slows runoff. Mechanical site preparation can potentially impact water quality in areas that have steep slopes and erodible soils, and where the prepared site is located near a waterbody. Use of mechanical site preparation treatments that expose mineral soils

on steep slopes can greatly increase erosion and landslide potential. Alternative methods, such as drum chopping, herbicide application, or prescribed burning, disturb the soil surface less than mechanical practices.

The pollution prevention practices that can be used during site preparation operations include:

- Mechanical site preparation should not be applied on slopes greater than 30 percent.
- Mechanical site preparation should not be conducted in streamside management areas. Also avoid mechanical site preparation operations during periods of saturated soil conditions that may cause rutting or accelerate soil erosion.
- Avoid working downhill or uphill. Always work along the contour. Site preparation often involves soil disturbance and can cause extensive erosion if done in a way that increases runoff potential. Leave strips of undisturbed soil to help catch any runoff on steep slopes.
- When moving slash and debris into rows, avoid pulling up topsoil with the debris. Many sites are degraded by the removal of topsoil. Make sure that the dozer operator monitors the operation closely and modifies his/her approach if soil begins to build up in the rows.
- Use haystack piling where possible instead of windrows.
- Locate windrows and piles away from drainages to prevent movement of materials during high-runoff conditions.
- Do not place slash in natural drainages, and remove any slash that accidentally enters drainages.
- Provide filter strips of sufficient width to protect drainages that do not have streamside management areas from sedimentation by the 10-year storm event.

III.C.4. Forest Regeneration

Forest regeneration refers to the re-establishment of a forest cover on areas from which trees have been removed by some past occurrence, such as wildfire, timber harvesting, or temporary conversion to some other use than the growing of trees. When trees have been absent from a site for a number of years, regeneration must generally be achieved through seeding and planting. Regeneration of a harvested area includes both the natural regenerative process and man's activities in preparing the site and subsequent planting or seeding. The method of regeneration is determined largely by the silvical characteristics of the tree species involved, site limitations, economic considerations, and the land manager's desire for forest composition. In some plant communities, natural regeneration under any of the harvesting systems may also occur by regrowth from roots or stumps.

Preparation, as well as protection of an area, is sometimes needed for regrowth of a stand. Where site preparation for regrowth is needed, major activities may include (1) debris removal to reduce fire hazard and allow use of equipment for subsequent operations, (2) reduction or removal of brush or shrub cover and undesirable tree species, and (3) cultivation of the soils.

Potential Pollution Outputs and Environmental Impacts

The pollution outputs may include air emissions from machinery used for regeneration, sediment runoff caused by soil-disturbing machinery, and nutrient runoff from fertilizer applications.

When used indiscriminately for site preparation, fire, chemicals, and soil-disturbing machinery increase the potential for erosion and sedimentation and other pollution to occur. The impacts from sediment pollution as well as pollution from nutrients in runoff would be similar to those discussed in Sections III.A.1 and III.A.3, respectively. The time required before such pollution occurs is variable depending upon climatic factors, soil productivity and its influence on the rate of plant growth, the species planted or seeded, and the operational schedule. In some areas, the time span may be a single growing season, while in others, it may cover several years.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in forest regeneration are designed to minimize sediment runoff caused by soil-disturbing machinery and nutrient runoff from fertilizer applications. Regeneration of harvested forest lands not only is important in terms of restocking a valuable resource, but also is important to provide

water quality protection from disturbed soils. Tree roots stabilize disturbed soils by holding the soil in place and aiding soil aggregation, decreasing slope failure potential. The presence of vegetation on disturbed soils also slows storm runoff, which in turn decreases erosion.

Mechanical planting using machines that scrape or plow the soil surface can produce erosion rills, increasing surface runoff and erosion. Natural regeneration, hand planting, and direct seeding minimize soil disturbance, especially on steep slopes with erodible soils. Fertilizers are occasionally introduced into forests to promote growth. Impacts of fertilizer application in forested areas could be significantly reduced by avoiding application techniques that could result in direct deposition into waterbodies and by maintaining a buffer area along the streambank.

The pollution prevention practices that can be used for forest regeneration operations include the following:

- Distribute seedlings evenly across the site.
- Order seedlings well in advance of planting time to ensure their availability.
- Hand plant highly erodible sites, steep slopes, and lands adjacent to stream channels.
- Operate planting machines along the contour to avoid ditch formation.
- Apply fertilizers during maximum plant uptake periods to minimize leaching. Base fertilizer type and application rate on soil and/or foliar analysis.
- For aerial spray applications of chemicals, maintain and mark a buffer area of at least 50 feet (or as specified on the label) around all watercourses and waterbodies to avoid drift or accidental application of chemicals directly to surface water.

III.C.5. Prescribed Burning

Prescribed burning is used to prepare sites for regeneration, reduce uncontrolled fire hazard due to accumulation of litter and undergrowth,

control low value hardwoods and unwanted shrub species, improve wildlife habitat, provide disease control, and improve accessibility. Fire is used deliberately under conditions where the area to be burned is predetermined and the intensity of fire is controlled.

Potential Pollution Outputs and Environmental Impacts

The pollution outputs may include air emissions (smoke) from the fire and soil erosion after the prescribed burning. Prescribed burning of slash can increase erosion by eliminating protective cover and altering soil properties. The degree of erosion following a prescribed burn depends on soil erodibility, slope, precipitation timing, precipitation volume and intensity, fire severity, cover remaining on the soil, and speed of revegetation. Burning may also increase storm runoff in areas where all vegetation is killed. Such increases are partially attributable to decreased evapotranspiration rates and reduced canopy interception of precipitation. Erosion resulting from prescribed burning is generally less than that resulting from roads and skid trails and from site preparation that causes intense soil disturbance. However, significant erosion can occur during prescribed burning if the slash being burned is collected or piled, causing soil to be moved and incorporated into the slash. The impacts of erosion and sediment runoff would be similar to those discussed in Section III.A.1.

Air emissions (smoke) from prescribed burning can have adverse effects on smoke sensitive areas such as airports, resorts or recreation areas, schools, hospitals, stock barns and holding pens, etc. Smoke can cause reduced visibility or smoke irritation to livestock and humans which may cause material loss and adverse health effects.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in prescribed burning are designed to minimize sediment runoff caused by removal of surface cover and smoke from fire. Prescribed burning is usually the least expensive method of obtaining several specific goals in forest management. However, it should be planned well in advance to assure success. Aerial photographs can be very helpful. Areas that will benefit most from a prescribed burn should be selected and priorities should be set. High priority will probably be protection of unmerchantable size stands. Burning stands can facilitate regeneration and reduce site preparation costs.

If recommended burning techniques and weather conditions are followed, most prescribed burning will not create smoke problems.

First, land managers should determine if any smoke sensitive areas are near the burn. These are places where reduced visibility or smoke irritation to livestock and humans could cause material loss and adverse health effects. Examples of smoke sensitive areas are: airports, heavily traveled highways, communities, resorts or recreation areas, schools, hospitals, factories, stock barns and holding pens.

Prescribed burning should not be implemented if any sensitive area is within three fourths of a mile downwind of the burn. Different wind direction should be sought in these type of situations. Also, burning should not be conducted if the area already has air pollution or a visibility problem. Burning should be carried out only when the vertical dispersion is good (from fire weather forecast).

The pollution prevention practices that can be used during prescribed burning operations include the following:

- Carefully plan burning to adhere to weather, time of year, and fuel conditions that will help achieve the desired results and minimize impacts on water quality.
- Intense prescribed fire for site preparation should not be conducted in the streamside management areas.
- Piling and burning for slash removal purposes should not be conducted in the streamside management areas.
- Avoid construction of firelines in the streamside management areas.
- In prescriptions for burns, avoid conditions requiring extensive blading of firelines by heavy equipment.
- Use natural or in-place barriers (e.g., roads, streams, lakes, wetlands) as an acceptable way to minimize the need for fireline construction in situations where artificial construction of firelines will result in excessive erosion and sedimentation.
- Construct firelines in a manner that minimizes erosion and sedimentation and prevents runoff from directly entering watercourses.
- Revegetate firelines with adapted herbaceous species.

- Execute the burn with a trained crew and avoid intense burning.
- Avoid burning on steep slopes with high erosion hazard areas or highly erodible soils.

III.C.6. Application of Chemicals

Chemicals are becoming more and more a part of forestry. Commercial fertilizers are applied to sizeable areas of forests as a means of stimulating growth of new plantations or established stands of trees. Herbicides are used widely for site preparation and stand improvement. Insecticides are used less extensively, but still comprise the major defense against damaging insects in forests.

Potential Pollution Outputs and Environmental Impacts

The potential outputs from application of forest chemicals may include runoff contaminated with chemicals associated with fertilizer and pesticide application, and chemical air emissions. Fertilizer loss may occur when fertilizers are improperly applied during the course of a silvicultural operation. Soluble forms of fertilizers may reach surface or groundwater through runoff, seepage, and/or percolation. Insoluble forms may be adsorbed on soil particles and reach surface water through erosion processes. Nutrients may also reach surface water by direct washoff of slash, debris, and recently applied fertilizer. Excessive nutrients can lead to imbalance in the natural life cycles of water bodies.

Pesticides, when applied during forest management operations, may be insoluble or soluble. Pesticides when applied aerially and in a broadcast manner may directly enter the surface waters. These chemicals then follow approximately the same pattern as nutrients. Pesticides, applied by the above methods, in a manner inconsistent with the label, may result in acute toxicity problems in water bodies.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in operations associated with the application of chemicals are designed to minimize runoff contaminated with chemicals from fertilizer and pesticide application, and chemical air emissions. Nutrient pollution from fertilization on forest lands is controlled by using techniques which avoid direct application to surface waters. Also involved are the elimination of excessive applications, the selection of the proper fertilizer

formulation, and the proper timing and method of application. The key factors in the selection of the type of fertilizer and the method of application which are most appropriate for pollution control are local soil nutrient deficiencies, the physical condition of the soil, the plant species requirements, cost factors, weather conditions, access, and topography.

The most common mechanism of pesticide pollution is direct transport by runoff. However, the mechanisms of leaching or subsurface flows may be important in areas of highly porous geologic materials, permeable soils, or high water tables. Practices that control erosion and runoff also reduce loss of applied pesticides. In addition to these practices, a number of other frequently used options exist. These options involve manipulation of the pesticide itself such as form, timing of application, etc. These can be used alone or in conjunction with the erosion and runoff control measures.

The pollution prevention practices that can be used during the application of forest chemicals include the following:

- For aerial spray applications, maintain and mark a buffer area of at least 50 feet around all watercourses and waterbodies to avoid drift or accidental application of chemicals directly to surface water. Also use nozzles and spray equipment that will reduce pesticide drift. With broadcast applications, use thickening agents, lower pressures, and larger nozzle sizes to keep the pesticide spray where it is applied.

- Apply pesticides and fertilizers during favorable weather conditions.

- Always use pesticides in accordance with label instructions, and adhere to all federal and state policies and regulations governing pesticide use. The pesticide label may specify: whether users must be trained and certified in the proper use of the pesticide; allowable use rates; safe handling, storage, and disposal requirements; and whether the pesticide can only be used under the provision of an approved Pesticide State Management Plan. Management measures and practices for pesticides should be consistent with and/or complement those in the approved Pesticide State Management Plans.

- Locate mixing and loading areas, and clean all mixing and loading equipment thoroughly after each use, in a location where pesticide residues will not enter streams or other waterbodies.
- Dispose of pesticide wastes and containers according to state and federal laws.
- Take precautions to prevent leaks and/or spills.
- Develop a spill contingency plan that provides for immediate spill containment and cleanup, and notification of proper authorities.
- Apply slow-release fertilizers, when possible.
- Apply fertilizers during maximum plant uptake periods to minimize leaching.
- Base fertilizer type and application rate on soil and/or foliar analysis.
- Consider the use of pesticides as part of an overall program to control pest problems.
- Base selection of pesticide on site factors and pesticide characteristics.
- Check all application equipment carefully, particularly for leaking hoses and connections and plugged or worn nozzles. Calibrate spray equipment periodically to achieve uniform pesticide distribution and rate.

IV. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulatory requirements.

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations (CFR) and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute. For specific agricultural information, contact The National Agricultural Compliance Assistance Center at (888) 663-2155 or visit the website at http://www.epa.gov/oeca/ag.

IV.A. General Description of Major Statutes

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either "toxic" pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and "indirect" dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and 1 territory to administer the NPDES program), contain industry-specific, technology-based and water quality-based

limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR §122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products

(except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA § 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands

Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in Section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. EPA's authority under Section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the Section 404 program to the states.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed

through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Oil Pollution Prevention Regulation

Section 311(b) of the CWA prohibits the discharge of oil, in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of Section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990 Congress passed the Oil Pollution Act which amended Section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United Stated or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. 40 CFR § 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with DPCC plans, required by the state, provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to 1 million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past 5 years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. FRPs that meet EPA's requirements can be combined with U.S. Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added Section 6217 (16 U.S.C. § 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The Section 6217 program is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Agency (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under Section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds at http://www.epa.gov/owow or from the Watershed Information Network at http://www.epa.gov/win. The NOAA website at http://www.nos.noaa.gov/ocrm/czm/ also contains additional information on coastal zone management.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is often state/tribe-enforced, since EPA has authorized many states/tribes to administer the program. Currently, EPA shares the UIC permit program responsibility in seven states and completely runs the program in 10 states and on all tribal lands.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1) delineating the source water protection area, (2) conducting a contaminant source inventory, (3) determining the

susceptibility of the public water supply to contamination from the inventories sources, and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at http://www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR 262.34) without a permit or interim status.

Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit. Subtitle C permits for treatment, storage, or disposal facilities contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

  EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating

certain emergency response activities and for appointing Local Emergency Planning Committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA § 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA § 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA § 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR 302) or an EPCRA extremely hazardous substance.

- **EPCRA § 311 and § 312** requires a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA § 313** requires certain covered facilities, including SIC codes 20 through 39 and others, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under §110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and will become effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (*see* 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the

CAA further directs EPA to develop a list of sources that emit any of 188 HAPs, and to develop regulations for these categories of sources. To date, EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996. Methyl bromide, a common pesticide, has been identified as a significant stratospheric ozone depleting chemical. The production and importation of methyl bromide, therefore, is currently being phased out in the United States and internationally. As specified in the Federal Register of June 1, 1999 (Volume 64, Number 104) and in 40 CFR Part 82, methyl bromide production and importation will be reduced from 1991 levels by 25% in 1999, by 50% in 2001, by 70% in 2003, and completely phased out by 2005. Some uses of methyl bromide, such as the production, importation, and consumption of methyl bromide to fumigate commodities entering or leaving the United States or any state (or political subdivision thereof) for purposes of compliance with Animal and Plant Health Inspection Service requirements or with any international, federal, state, or local sanitation or food protection standard, will be exempt from this rule. After 2005, exceptions may also be made for critical agricultural uses. The United States EPA and the United Nations Environmental

Programme have identified alternatives to using methyl bromide in agriculture. Information on methyl bromide phase-out, including alternatives can be found at the EPA Methyl Bromide Phase-Out Web Site: (http://www.epa.gov/docs/ozone/mbr/mbrqa.html).

EPA's Clean Air Technology Center, at (919) 541-0800 and at the Center's homepage at www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996 and at http://www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Hotline, at (800) 535-0202 and at http://www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA §112(r); and information on air toxics can be accessed through the Unified Air Toxics website at http://www.epa.gov/ttn/uatw. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration

Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enforcement authority for facilities/persons that are not in compliance with FIFRA.

Product Registration

Under §3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the United States must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site, i.e., where the product may be used, and the amount that may be applied. The person who seeks to register the pesticide must file an application

for registration. The application process often requires either the citation or submission of extensive environmental, health and safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under §408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA § 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be requested to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA § 3(c)(2)(B) and § 4.

Use Restrictions

As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration

Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (§ 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions

A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a

tolerance (40 CFR.163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension

EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order that makes the suspension immediately effective.

Imports and Exports

Under FIFRA § 17(a), pesticides not registered in the United States and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified in 40 CFR § 168.65, 168.75, and 168.85.

Under FIFRA §17(c), imported pesticides and devices must comply with United States pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA §17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. United States Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to United States Customs when the shipment arrives in the

United States NOA forms can be obtained from contacts in the EPA Regional Offices or www.epa.gov/oppfead1/international/noalist.htm.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs' homepage at www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture and Ecosystem Division at http://es.epa.gov/oeca/agecodiv, or The National Agriculture Compliance Assistance Center toll-free at (888) 663-2155 or http://www.epa.gov/oeca/ag. Other sources include the National Pesticide Telecommunications Network toll-free at (800) 858-7378 and the National Antimicrobial Information Network toll-free at (800) 447-6349.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA § 6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under § 6 authority are asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs).

Under TSCA § 8(e), EPA requires the producers and importers (and others) of chemicals to report information on a chemicals' production, use, exposure, and

risks. Companies producing and importing chemicals can be required to report unpublished health and safety studies on listed chemicals and to collect and record any allegations of adverse reactions or any information indicating that a substance may pose a substantial risk to humans or the environment.

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

IV.B. Industry-Specific Requirements for Agricultural Production Industries: Crops, Greenhouses/Nurseries, and Forestry

The agricultural production industries discussed in this notebook are regulated by several different federal, state, and local agencies. EPA has traditionally relied on delegation to states to meet environmental standards, in many cases without regard to the methods used to achieve certain performance standards. This has resulted in some states with more stringent air, water, and hazardous waste requirements than the federal minimum requirements. This document does not attempt to discuss state standards, but rather highlights relevant federal laws and proposals that affect the agricultural production industries of crops, greenhouses/nurseries, and forestry.

Clean Water Act

Under the CWA, there are five program areas that potentially affect agricultural establishments and businesses. These include: point source discharges, storm water discharges, nonpoint source pollution, wetland regulation, and sludge management. Key provisions addressing each of these areas are summarized below:

- **Point Source Discharges**: The CWA establishes a permitting program known as the NPDES program for "point sources" of pollution. The term "point source" includes facilities from which pollutants are or may be discharged to waters of the United States and is further defined at 40 CFR Part 122. If granted, the permit will place limits and conditions on the proposed discharges based on the performance of available control technologies and on any applicable (more stringent) water quality considerations. Usually the permit also will require specific compliance measures, establish schedules, and specify monitoring and reporting requirements.

  – **Concentrated Animal Feeding Operations (CAFOs):** The CWA defines CAFOs as point sources. Therefore, CAFOs are

subject to the NPDES permitting program. See 40 CFR Part 122.23 and 40 CFR 122 Appendix B. A CAFO is prohibited from discharging pollutants to waters of the U.S. unless it has obtained an NPDES permit for the discharge.

Definition of an AFO – An AFO is defined in EPA regulations as a lot or facility where (1) animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and (2) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

Definition of a CAFO – CAFOs are a subset of all AFOs. Whether an AFO is a CAFO under the regulations depends on the number of animals confined at the facility. A CAFO is defined as follows:

(1) ***More than 1,000 AUs*** are confined at the facility [40 CFR 122, Appendix B (a)]; **OR**

(2) ***From 301 to 1,000 AUs*** are confined at the facility ***and***:

< Pollutants are discharged into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device; or

< Pollutants are discharged directly into waters of the U.S. that originate outside of and pass over, across, or through the facility or come into direct contact with the confined animals. [40 CFR 122, Appendix B (b)] ***OR***

(3) The facility has been **designated as a CAFO** by the permitting authority on a ***case-by-case basis*** [40 CFR 122.23(c)], based on the permitting authority's determination that the operation is a "significant contributor of pollution." In making this determination, the permitting authority considers the following factors:

- Size of the operation;

- Amount of waste reaching waters of the United States;
- Location of the operation relative to waters of the U.S.;
- The means of conveyance of animal wastes and process wastewater into waters of the United States;
- The slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of animal wastes and process wastewater into waters of the U.S.; and
- Other relevant factors (e.g.,waste handling and storage, land application timing, methods, rates and areas, etc.).

A permit application shall not be required from a concentrated animal feeding designated under the case-by-case authority until after the Director has conducted an on-site inspection and determined that the operation should and could be regulated under the NPDES permit program.

No animal feeding operation with less than the number of animals set forth in 40 CFR 122, Appendix B shall be designated as a concentrated animal feeding operation unless either (1) pollutants are discharged into waters of the U.S. through a manmade ditch, flushing system, or other similar means, or (2) pollutants are discharged directly into waters of the U.S. which originate outside of the facility and pass over, across, or through the facility, or otherwise come into direct contact with the animals confined in the operation.

The NPDES permit regulations [40 CFR 122, Appendix B] contain an

> A 25-year, 24-hour rainfall event means the maximum precipitation event with a probable occurrence of once in 25 years, as defined by the National Weather Service in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments, or equivalent regional or information state rainfall probability developed therefrom [40 CFR Part 412.11(e)]

exemption for any AFO from being defined as a CAFO if it discharges only in the event of a 25 year, 24-hour, or larger, storm event. To be eligible for an exemption, the facility must demonstrate to the permitting authority that it has not had a discharge. It must also demonstrate that the entire facility is designed, constructed, and operated to contain a storm event of this magnitude in addition to process wastewater. An operation that qualifies for this exemption from being defined as a CAFO may still be designated as a CAFO by the permitting authority on a case-by-case basis.

- **Storm Water Discharges:** Under 40 CFR §122.2, the definition of "point source" excludes agricultural storm water runoff. Thus, such runoff is not subject to the storm water permit application regulations at 40 CFR §122.26. Non-agricultural storm water discharges, however, are regulated if the discharge results from construction over 5 acres or certain other types of industrial activity such as landfills, automobile junk yards, vehicle maintenance facilities, etc.

  – **Concentrated Aquatic Animal Production Facilities:** Under 40 CFR Part 122.24, a *concentrated aquatic animal production facility* is defined and designated as a point source subject to the NPDES permit program.

    Definition of concentrated aquatic animal production facility (40 CFR Part 122 Appendix C) -- A *concentrated aquatic animal production facility* is a hatchery, fish farm, or other facility that meets one of the following criteria:

    (1) A facility that contains, grows, or holds cold water fish species or other cold water aquatic animals in ponds, raceways, or similar structures which discharge at least 30 days per year. The term does not include (a) facilities which produce less than 9,090 harvest weight kilograms (approximately 20,000 pounds) of aquatic animals per year, and (b) facilities which feed less than 2,272 kilograms (approximately 5,000 pounds) of food during the calendar month of maximum feeding. Cold water aquatic animals include, but are not limited to, the *salmonidae* family (e.g., trout and salmon).

(2) A facility that contains, grows, or holds warm water fish species or other warm water aquatic animals in ponds, raceways, or similar structures which discharge at least 30 days per year. The term does not include (a) facilities which produce 45,454 harvest weight kilograms (approximately 100,000 pounds) of aquatic animals per year or (b) closed ponds which discharge only during periods of excess runoff. Warm water aquatic animals include, but are not limited to, the *Ameiuridae*, *Centrarchidae,* and *Cyprinidae* families of fish (e.g., respectively catfish, sunfish, and minnows).

Designated facility -- A facility that does not otherwise meet the criteria in 40 CFR Part 122 Appendix C (described above) may be *designated* as a concentrated aquatic animal production facility if EPA or an authorized state determines the production facility is a significant contributor of pollution to waters of the U.S. No permit is required for such a designated facility until the EPA or state officials have conducted an onsite inspection and determined that the facility should be regulated under the NPDES permit program.

– **Aquaculture Projects**: Under 40 CFR Part 122.25(b), *aquaculture* means a defined, managed water area that uses discharges of pollutants to maintain or produce harvestable freshwater, estuarine, or marine plants or animals. Discharges into approved aquaculture projects are not required to meet effluent limitations that might otherwise apply. The entire aquaculture project (discharges into and out of the project) is addressed in an NPDES permit.

– **Exemption for Irrigation Return Flows:** Under 40 CFR Part 122.3(f), return flows from irrigated agriculture do not require NPDES permits.

– **Wastewater Guidelines for Point Source Silviculture Activities:** Under 40 CFR §122.27, silvicultural point sources are subject to the NPDES permit program. Such silviculture point sources include discrete conveyances related to rock crushing, gravel washing, log sorting or log storage facilities operated in connection with silvicultural activities and from which pollutants are

discharged into waters of the U.S. The term does not include non-point source silviculture activities such as nursery operations, site preparation, reforestation, thinning, prescribed burning, pest and fire control, harvesting operations, surface drainage, or road construction and maintenance from which there is natural runoff.

- **Nonpoint Source Pollution:** Under the CWA §319 Nonpoint Source (NPS) Management Program and 40 CFR §130.6, states (tribes, and territories) establish programs to manage NPS pollution, including runoff and leaching of fertilizers and pesticides, and irrigation return flows. These NPS management programs must identify: (a) best management practices (BMPs) to be used in reducing NPS pollution loadings; (b) programs to be used to assure implementation of BMPs; (c) a schedule for program implementation with specific milestones; and (d) sources of federal or other funding that will be used each year for the support of the state's NPS pollution management program. Congress provides grant funds to the states annually for the administration of these management programs.

- **Discharges to Publicly Owned Treatment Works (POTWs):** Under 40 CFR Part 403, facilities, including agricultural establishments, may discharge certain substances to a POTW if the facility has received prior written permission from the POTW and has completed any required pretreatment. Facilities must check with their POTWs for information about permitted discharges and for conditions and limitations.

- **Discharges of Designated Hazardous Substances.** Under 40 CFR Parts 116-117, facilities, including agricultural establishments, must immediately notify the National Response Center (1-800-424-8802) and their state agency of any unauthorized discharge of a designated hazardous substance into (1) navigable waters, (2) the shorelines of navigable waters, or (3) contiguous zones, IF the quantity discharged in any 24-hour period equals or exceeds the reportable quantity. A *designated hazardous substance* is any chemical listed in Section 311 of the Clean Water Act. The *reportable quantity* is the amount of the hazardous substance that EPA has determined might cause harm. The list of hazardous substances along with each chemical's reportable quantity is found in 40 CFR Parts 116 and 117. Ammonia and several pesticides are on the list.

- **Discharges of Oil**. Under 40 CFR Part 110, facilities must immediately notify EPA's National Response Center (1-800-424-8802) of any unauthorized discharge of a *harmful quantity of oil* (including petroleum, fuel oil, sludge, oil refuse, or oil mixed with other wastes) into (1) navigable

waters, (2) the shorelines of navigable waters, or (3) contiguous zones and beyond. A discharge of oil is considered harmful if it violates applicable water quality standards, causes a sludge or emulsion to be deposited under the surface of the water or on adjoining shorelines, or causes a film or sheen on, or discoloration of, the water or adjoining shorelines. In practice, any quantity of oil or a petroleum product is a harmful quantity, since even small amounts will cause a film or sheen on surface water.

– **Oil Spill Prevention Control and Countermeasure (SPCC) Program**: Under 40 CFR Part 112, facilities, including agricultural establishments, must comply with EPA's SPCC program when they store oil at their facility. SPCC requirements apply to non-transportation related onshore and offshore facilities of specified size engaged in storing, processing, refining, transferring or consuming oil products, which due to their location, could potentially discharge oil into waters of the U.S. or adjoining shorelines.

  Facilities must comply with the SPCC program: (1) if they have a single aboveground container with an oil storage capacity of more than 660 gallons, multiple aboveground containers with a combined oil storage capacity of more than 1,320 gallons, or a total underground oil storage capacity of more than 42,000 gallons *and* (2) if there is a reasonable expectation that a discharge (spill, leak, or overfill) from the tank will release harmful quantities of oil into navigable waters or adjoining shorelines. The requirements are triggered by tank capacity, regardless of whether tanks are completely filled.

  Facilities subject to the SPCC requirements must prepare an SPCC plan. This plan must include: (1) *prevention* measures that keep oil releases from occurring, (2) *control* measures installed to prevent oil releases from reaching navigable waters, and (3) *countermeasures* to contain, clean up, and mitigate the effects of any oil release that reaches navigable waters. Each plan must be unique to the facility and must be signed by a registered professional engineer.

• **Wetlands on Agricultural Lands**: Swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes are common names for wetlands. Wetlands provide a habitat for threatened and endangered species as well as a diversity of other plant, wildlife, and fish species. In addition to

providing habitat, wetlands serve other functions, including stabilizing shorelines; storing flood waters; filtering sediments, nutrients, and toxic chemicals from water; and providing an area for the recharge and discharge of groundwater. It is important to note that not all wetlands will be obvious to the untrained observer. For example, an area can appear dry during much of the year and still be classified as a wetland. Your local Natural Resources Conservation Service (NRCS) office can help to identify and delineate wetlands on your property.

NRCS, formerly the Soil Conservation Service, is the lead agency for identifying wetlands on *agricultural lands*. According to NRCS, agricultural lands means those lands intensively used and managed for the production of food or fiber to the extent that the natural vegetation has been removed and therefore does not provide reliable indicators of wetland vegetation. Areas that meet this definition may include intensively used and managed cropland, hayland, pastureland, orchards, vineyards, and areas that support wetland crops (e.g., cranberries, taro, watercress, rice). Lands not included in the definition of *agricultural lands* include rangelands, forest lands, woodlots, and tree farms.

– ***Exemption to Section 404 Permit Requirements.*** The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. The 404 permit program requires a permit for point source discharges of dredged and fill material into waters of the United States. However, many normal established farming activities (e.g., plowing, cultivating, minor drainage, and harvesting), silviculture, and ranching activities that involve discharges of dredged or fill materials into U.S. waters are **exempt from Section 404 permits** and do **NOT** require a permit (33 CFR §323.4). In order to be exempt, the activity must be part of an ongoing operation and cannot be associated with bringing a wetland into agricultural production or converting an agricultural wetland to a non-wetland area.

  If not covered by the above exemption, a permit is required before discharging dredged or fill material into U.S. waters, including most wetlands (33 CFR Part 323). The Army Corps of Engineers (Corps) reviews Section 404 permit applications to determine if a

project is the least environmentally damaging and practicable alternative.

- **POTW Sludge Management - Land Application of Biosolids**. Land application is the application of biosolids to land to either condition the soil or fertilize crops or other vegetation grown in the soil. Biosolids are a primarily organic solid product produced by wastewater treatment processes that can be beneficially recycled.

  EPA regulates the land application of biosolids under 40 CFR Part 503. As described in *A Plain English Guide to the EPA Part 503 Biosolids Rule* (EPA/832/R-93-003, September 1994), the Part 503 rule includes general provisions, and requirements for land application, surface disposal, pathogen and vector attraction reduction, and incineration. For each regulated use or disposal practice, a Part 503 standard includes general requirements, pollutant limits, management practices, operational standards, and requirements for the frequency of monitoring, recordkeeping, and reporting. For the most part, the requirements of the Part 503 rule are ***self-implementing*** and must be followed even without the issuance of a permit covering biosolids use or disposal requirements.

- **Total Maximum Daily Load (TMDL) program**. There are still waters in the nation that do not meet the CWA national goal of "fishable, swimmable" despite the fact that nationally required levels of pollution control technology have been implemented by many pollution sources. The TMDL program, established under Section 303(d) of the Clean Water Act, focuses on identifying and allocating pollutant loads to these waterbodies. The goal of a TMDL is the attainment of water quality standards.

  A TMDL identifies the amount a pollutant needs to be reduced to meet water quality standards, allocates pollutant load reductions among pollutant sources in a watershed, and provides the basis for taking actions needed to restore a waterbody. It can identify the need for point source and nonpoint source controls.

  Under this provision, States are required to (1) identify and list waterbodies where State water quality standards are not being met following the application of technology-based point source pollution controls; and (2) establish TMDLs for these waters. EPA must review and approve (or disapprove) State lists and TMDLs. If state actions are not adequate, EPA must prepare lists and TMDLs. TMDLs are to be implemented using existing federal, state, and local authorities and voluntary programs.

TMDLs should address all significant pollutants which cause or threaten to cause waterbody use impairment, including:

- Point sources (e.g., sewage treatment plant discharges)
- Nonpoint sources (e.g., runoff from fields, streets, range, or forest land)
- Naturally occurring sources (e.g., runoff from undisturbed lands)

A TMDL is the sum of the individual wasteload allocations for point sources, load allocations for nonpoint sources and natural background pollutants, and an appropriate margin of safety. TMDLs may address individual pollutants or groups of pollutants, as long as they clearly identify the links between: (1) the waterbody use impairment or threat of concern, (2) the causes of the impairment or threat, and (3) the load reductions or actions needed to remedy or prevent the impairment.

TMDLs may be based on readily available information and studies. In some cases, complex studies or models are needed to understand how pollutants are causing waterbody impairment. In many cases, simple analytical efforts provide an adequate basis for pollutant assessment and implementation planning.

Where inadequate information is available to draw precise links between these factors, TMDLs may be developed through a phased approach. The phased approach enables states to use available information to establish interim targets, begin to implement needed controls and restoration actions, monitor waterbody response to these actions, and plan for TMDL review and revision in the future. Phased approach TMDLs are particularly appropriate to address nonpoint source issues.

Numerous TMDLs are under development in many states and TMDLs are likely to impact agricultural activities by prompting states and stakeholders to mitigate water pollution caused by agricultural sources (assuming agriculture-related industries are identified as significant contributors to water quality impairment).

Coastal Zone Act Reauthorization Amendments of 1990

The Coastal Nonpoint Pollution Control Program, which is implemented under the authority of Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Agency (NOAA). The Section 6217 program

requires the 29 states and territories with NOAA-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. These programs are intended to serve as an update and expansion of existing state programs focused on nonpoint source pollution affecting coastal areas. These submitted programs must include: (1) management measures that are in conformity with applicable federal guidance and (2) state-developed management measures as necessary to achieve and maintain applicable water quality standards.

On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters.* The federal guidance specifies management measures for the following agricultural sources: (1) erosion from cropland, (2) confined animal facilities, (3) the application of nutrients to croplands, (4) the application of pesticides to cropland, (5) grazing management, and (6) irrigation of cropland.

Once approved, the programs are implemented through state nonpoint source programs (under CWA §319) and state coastal zone management programs (authorized under §306 of the Coastal Zone Management Act). Agricultural establishments located in coastal states should determine whether their land is included in the state's coastal management area. If so, they must comply with their state's applicable coastal nonpoint programs. Currently, all state coastal nonpoint management programs have been conditionally approved and have begun to be implemented.

Coastal Zone Management Act

The 1996 amendments to the Coastal Zone Management Act that may affect agriculture-related industries include those that relate to aquaculture in the coastal zone. Eligible states may now receive grants for developing a coordinated process among state agencies to regulate and issue permits for aquaculture facilities in the coastal zone. States may also receive grants for adopting procedures and policies to evaluate facilities in the coastal zone that will enable the states to formulate, administer, and implement strategic plans for marine aquaculture. Each state that receives such grants will make its own determination as part of its coastal management plan on how to specifically use the funds. Therefore, persons engaged in aquaculture productivity in the coastal zone may be eligible for technical or financial assistance under their state's plan.

Safe Drinking Water Act

The SDWA, which has been amended twice since 1974, protects the water supply through water quality regulations and source protection, such as underground

injection control (UIC) regulations. SDWA requirements apply to all public water systems (PWSs). Currently, 54 of 56 states and territories have been delegated primacy to run the drinking water program.

- **Public Water Systems**. Under 40 CFR Parts 141-143, facilities that operate a PWS or receive water from a PWS and provide treatment to it are subject to SDWA regulations. Prior to 1996, SDWA defined a PWS as "a system for the provision to the public of piped water *for human consumption* if such system has at least 15 service connections or regularly serves at least 25 individuals." The 1996 Amendments expanded the means of delivering water to include not only pipes, but also other constructed conveyances such as ditches and waterways.

  While there are three categories of PWSs, an agricultural establishment will most likely operate a non-transient, non-community system. This type of system serves at least 25 people for over 6 months of the year, but the people generally do not live at the facility. All PWSs must comply with the national primary drinking water regulations (40 CFR 141). Under 40 CFR Part 141 Subpart G, EPA has established drinking water standards for numerous pesticides.

  Establishments that operate a non-transient, non-community system, in general, will need to: (1) monitor for the contaminants the state has established for that type of system, (2) keep records of the monitoring results, (3) report results from all tests and analyses to the state/tribe on a set schedule, (4) take immediate action to correct any violations in the allowable contaminant levels, (5) make a public announcement of any violations to warn people about potential adverse effects and to describe the steps taken to remedy the problem, and (6) keep records of actions taken to correct violations.

- **Comprehensive State Ground Water Protection Program**. Under the SDWA §1429, states/tribes are allowed to establish a Comprehensive State Ground Water Protection Program to protect underground sources of drinking water. Under this program, a state/tribe can require facilities, including agricultural establishments, to use designated best management practices (BMPs) to help prevent contamination of groundwater by nitrates, phosphates, pesticides, microorganisms, or petroleum products. These requirements generally apply only to facilities that are subject to the public water system supervision program. Persons applying pesticides or fertilizers must know the location of all the public water supply source areas

in the vicinity that are protected by state/tribal (and sometimes local) requirements.

- **Source Water Protection Program**. Under the SDWA, states are required to develop comprehensive Source Water Assessment Programs (SWAP). The statutorily defined goals for SWAPs are to provide for the protection and benefit of public water systems and for the support of monitoring flexibility. These programs plan to identify the areas that supply public tap water, inventory contaminants and assess water system susceptibility to contamination, and inform the public of the result.

- **Wellhead Protection Program**. Under the SDWA §1428, if a facility, has an onsite water source (e.g., well) that qualifies as a PWS, it must take the steps required by the state/tribe to protect the wellhead from contaminants. A wellhead protection area is the surface and subsurface area surrounding a water well or wellfield supplying a PWS through which contaminants are reasonably likely to move toward and reach such water well or wellfield.

  Since drinking water standards (40 CFR Part 141 Subpart G) exist for numerous pesticides, which may be used in various agriculture-related activities, some state/tribe and local wellhead and source water protection programs restrict the use of agricultural chemicals in designated wellhead protection areas. In addition, persons applying pesticides or fertilizers must know the location of all the public water supply source areas in the vicinity that are protected by state/tribal (and sometimes local) requirements, and the requirements for mixing, loading, and applying agricultural chemicals within any designated wellhead or source water protection areas.

- **Sole Source Aquifer Protection Program**. Under the SDWA §1424 and 40 CFR Part 149 Subpart B, EPA can establish requirements for protecting sole source aquifers. EPA designates an aquifer as a ***sole source aquifer*** if it supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer and no alternative drinking water sources are feasible. The Sole Source Aquifer program prohibits federal financial assistance (any grant, contract, loan guarantee, or otherwise) for any project, including agricultural projects, that may result in contamination to the aquifer and create a hazard to public heath. Currently, only a few aquifers have been designated as protected sole source aquifers.

- **Underground Injection Control (UIC) Program**. The UIC program (40 CFR Parts 144 and 146-148) is a permit program that protects underground sources of drinking water by regulating five classes of injection

wells (I - V). *Underground injection* means depositing fluids beneath the surface of the ground by injecting them into a hole (any hole that is deeper than it is wide). *Fluids* means any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.

If a facility disposes of (or formerly disposed of) waste fluids onsite in an injection well, it triggers the UIC requirements. In general, a facility may not inject contaminants into any well if the contaminant could cause a violation of any primary drinking water regulation or endanger an underground source of water if the activity would adversely affect the public health. Most deep well underground injections are prohibited without a UIC permit. No Class I, II, or III injection well may be constructed or opened before a permit has been issued. UIC permits include design, operating, inspection, and monitoring requirements. In many states/tribes, EPA has authorized the state/tribal agency to administer the program.

Class V Wells. Owners/operators of Class V wells (shallow wells that inject fluids above an underground source of water) must not construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation (40 CFR Part 142) or may otherwise adversely affect the health of persons. Examples of Class V wells potentially applicable to agricultural establishments include, but are not limited to:

- Drainage wells, such as agricultural drainage wells, primarily used for storm runoff.
- Cesspools with open bottoms (and sometimes perforated sides) and septic system wells used to inject waste or effluent from multiple dwellings or businesses (the UIC requirements do not apply to single family residential septic system or cesspool wells or to non-residential septic system or cesspool wells that are used solely for the disposal of sanitary wastes and have the capacity to serve fewer than 20 persons per day).
- Dry wells used for waste injection.
- Recharge wells used to replenish aquifers.

- Injection wells associated with the recovery of geothermal energy for heating, aquaculture, and production of electric power.

- Floor drains in maintenance shops/work areas.

Agricultural drainage wells typically drain water from low-lying farm land, but some serve to recharge aquifers from which irrigation water is withdrawn. These wells are usually constructed in areas with poor soil drainage, but where underlying geologic formations allow rapid infiltration of water. Sometimes abandoned water supply wells are adapted for use in agricultural drainage. Agricultural drainage wells typically receive field drainage from saturated topsoil and subsoil, and from precipitation, snowmelt, floodwaters, irrigation return flow, and animal feedlots. The types of pollutants injected into these wells include (1) pesticide runoff, (2) nitrate, nitrite, and salts, such as those of calcium, magnesium, sodium, potassium, chloride, sulfate, and carbonate from fertilizer runoff, (3) salts and metals (i.e., iron, lead, cadmium, and mercury) from biosolid sludges and compost, (4) microbes (i.e., bacteria and viruses) from animal waste runoff, and (5) petroleum contaminants, such as fuel and oil, from runoff

If a facility has a Class V well, it must furnish inventory information about the well to the appropriate state/tribal agency. If at any time EPA or the state/tribal agency learns that a Class V well may cause a violation of primary drinking water regulations (40 CFR Part 142) or may be otherwise adversely affecting the health of persons, it may require the injector to obtain an individual UIC permit, or order the injector to take such actions (including, where required, closure of the injection well) as may be necessary to prevent the violation.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) was enacted to address problems related to hazardous and solid waste management. RCRA gives EPA the authority to establish a list of solid and hazardous wastes and to establish standards and regulations for the treatment, storage, and disposal of these wastes. Regulations in Subtitle C of RCRA address the identification, generation, transportation, treatment, storage, and disposal of hazardous wastes. These regulations are found in 40 CFR Part 124 and 40 CFR Parts 260-279. Under RCRA, persons who generate waste must determine whether the waste is defined as solid waste or hazardous waste. Solid wastes are considered hazardous wastes

if they are listed by EPA as hazardous or if they exhibit characteristics of a hazardous waste: toxicity, ignitability, corrosivity, or reactivity.

Most agriculture-related activities do not generate significant amounts of hazardous waste. Generally, the activities potentially subject to RCRA involve the use of pesticides and fertilizers, and the use and maintenance of different types of machinery.

Hazardous Waste Generator Categories. Facilities that generate hazardous waste can be classified into one of three hazardous waste generator categories as defined in 40 CFR Part 262:

- ***Conditionally exempt small quantity generator (CESQG)***. A facility is classified as a CESQG if it generates no more than 220 lbs (100 kg) of hazardous waste in a calendar month. There is no time limit for accumulating #2,200 lbs of hazardous waste onsite. However, CESQGs cannot store more than 2,200 lbs (1,000 kg) of hazardous waste onsite at any time. In addition, CESQGs cannot accumulate onsite more than 2.2 lbs (1 kg) of acutely hazardous waste or more than 220 lbs spill residue from acutely hazardous waste for any period of time.

- ***Small quantity generator (SQG)***. A facility is classified as a SQG if it generates >220 lbs (100 kg) and <2,200 lbs (1,000 kg) of hazardous waste in a calendar month. SQGs can accumulate onsite no more than 13,200 lbs (6,000 kg) of hazardous waste. SQGs can store hazardous waste onsite for up to 180 days (or up to 270 days if the waste treatment/disposal facility is more than 200 miles away).

- ***Large quantity generator (LQG)***. A facility is classified as a LQG if it generates > 2,200 lbs (1,000 kg) of hazardous waste in a calendar month. While there is no limit on the amount of hazardous waste that LQGs can accumulate onsite, they can only store it onsite for up to 90 days.

If a facility is a CESQG and generates #2.2 lbs (1 kg) of acutely hazardous waste; or #220 lbs (100 kg) of acutely hazardous waste spill residues in a calendar month, and never stores more than that amount for any period of time, it may manage the acutely hazardous waste according to CESQG requirements. If it generates more than 2.2 lbs (1 kg) of acutely hazardous waste or >220 lbs (100 kg) of acutely hazardous waste spill residues in a calendar month, the facility must manage it according to LQG requirements.

The hazardous wastes that must be measured are those: (1) accumulated at the facility for any period of time before disposal or recycling, (2) packaged and transported away from the facility, (3) placed directly into a treatment or disposal unit at the facility, or (4) generated as still bottoms or sludges *and* removed from product storage tanks.

Requirements for CESQGs. Based on the quantity of hazardous waste generated per month, most agricultural establishments will qualify as CESQGs. As CESQGs, facilities must comply with three basic waste management requirements:

(1) Identify all hazardous waste generated.

(2) Do not generate per month more than 220 lbs (100 kg) of hazardous waste; more than 2.2 lbs (1 kg) of acutely hazardous waste; or more than 220 lbs (100 kg) of acutely hazardous waste spill residues; and never store onsite more than 2,200 lbs (1,000 kg) of hazardous waste; 2.2 lbs of acutely hazardous waste; or 220 lbs of acutely hazardous waste spill residues for any period of time.

(3) Ensure proper treatment and disposal of the waste. This means ensuring that the disposal facility is one of the following:

- A state or federally regulated hazardous waste management treatment, storage, or disposal facility.
- A facility permitted, licensed, or registered by a state to manage municipal or industrial solid waste.
- A facility that uses, reuses, or legitimately recycles the waste (or treats the waste before use, reuse, or recycling).
- A universal waste handler or destination facility subject to the requirements for universal wastes.

CESQGs are allowed to transport their own wastes to the treatment or storage facility, unlike SQGs and LQGs who are required to use a licensed, certified transporter. While there are no specific RCRA requirements for CESQGs who transport their own wastes, the U.S. Department of Transportation (DOT) requires all transporters of hazardous waste to comply with all applicable DOT regulations. Specifically, DOT regulations require all transporters, including CESQGs, transporting hazardous waste that qualifies as a DOT hazardous material to comply with EPA hazardous waste transporter requirements found in 40 CFR Part 263. CESQGs are not required by federal hazardous waste laws to train their employees on waste handling or emergency preparedness.

Requirements for SQGs and LQGs. Facilities determined to be SQGs or LQGs must meet many requirements under the RCRA regulations. These requirements, found in 40 CFR 260-279, include identifying hazardous waste; obtaining an EPA identification numbers; meeting requirements for waste accumulation and storage limits; container management; conducting personnel training; preparing a manifest; ensuring proper hazardous waste packaging, labeling, and placarding; reporting and recordkeeping; and contingency planning, emergency procedures, and accident prevention.

Notes: Facilities that fall into different generator categories during different months may choose to simplify compliance by satisfying the more stringent requirements all the time.

Specific Provisions. RCRA regulations include several specific provisions addressing agriculture-related materials and activities. Key provisions are briefly summarized below:

- ***Exemption for Certain Solid Wastes Used as Fertilizers***. Under 40 CFR §261.4(b), solid wastes generated by (1) growing and harvesting of agricultural crops, or (2) raising animals (including animal manure), and that are returned to the soils as fertilizers are excluded from regulation as hazardous waste.

- ***Exemption for Certain Hazardous Waste Pesticides***. Under 40 CFR §262.70, farmers who generate any amount of hazardous waste pesticides from their own use are excluded from the generator, treatment/storage/disposal facility, land disposal, and permit requirements under RCRA Subtitle C, provided that the farmer: (1) disposes of the waste pesticide in a manner consistent with the label on the pesticide container; (2) triple rinses each empty container in accordance with requirements at 40 CFR §261.7(b)(3); and (3) disposes of the rinsate on his own farm in accordance with the instructions on the label. If the label does not include disposal instruction, or no instructions are available from the pesticide manufacturer, the waste pesticide and rinsate must be disposed of in accordance with Subtitle C hazardous waste requirements. (Also see 40 CFR Part 165 - FIFRA).

- ***Exemption for Commercial Fertilizers***. Under 40 CFR §266.20, commercial fertilizers produced for general public (including agricultural) use that contain recyclable materials are not presently subject to regulation provided they meet the applicable land disposal restriction (LDR) standards for each recyclable material they contain. For example, zinc-containing

fertilizers containing K061 (emission control dust from the primary production of steel in electric furnaces) are not subject to regulation.

- ***Fertilizers Made from Hazardous Wastes***. Under 40 CFR Parts 266 and 268, EPA regulates fertilizers containing hazardous wastes as ingredients. Hazardous wastes may be used as ingredients in fertilizers under certain conditions, since such wastes can be a beneficial component of legitimate fertilizers. EPA has established standards that specify limits on the levels of heavy metals and other contents used as fertilizer ingredients. These standards are based on treatment, by the best technology currently available, to reduce the toxicity and mobility of all the contents of the hazardous waste components. These standards are based on waste management considerations and do not include consideration of the potential agronomic or dietary risk.

- ***Food Chain Crops Grown on Hazardous Waste Land Treatment Units***. Under 40 CFR Part 264.276, food chain crops (including feed for animals consumed by humans) may be grown in or on hazardous waste land treatment units under certain conditions and only with a permit. The permit for a facility will list the specific food-chain crops that may be grown. To obtain a permit, the owner/operator of the facility wishing to grow the food-chain crops must demonstrate -- prior to the planting of such crops -- that there is no substantial risk to human health caused by the growth of such crops in or on the treatment zone.

- ***Solid Waste Disposal Criteria***. Under RCRA Subtitle D, 40 CFR 257.3 establishes solid waste disposal criteria addressing floodplains, endangered species, groundwater protection, application to land used for food chain crops, disease vectors, air pollution, and safety. These criteria are largely guidelines used by states in developing solid waste regulations, which control the disposal of waste on a farmer's property.

- ***Land Application of Fertilizers Derived from Drinking Water Sludge***. Under 40 CFR Part 257, EPA regulates the land application of solid wastes, including drinking water sludge applied as fertilizer. These requirements include: (1) cadmium limits on land used for the production of food-chain crops (tobacco, human food, and animal feed) or alternative less stringent cadmium limits on land used solely for production of animal feed; (2) polychlorinated biphenyls (PCBs) limits on land used for producing animal feed, including pasture crops for animals raised for milk; and (3) minimization of disease vectors, such as rodents, flies, and

mosquitoes, at the site of application through incorporation of the fertilizer into soil so as to impede the vectors' access to the sludge.

- ***Pesticides That Are Universal Wastes***. Under 40 CFR Part 273, EPA has established a separate set of requirements for three types of wastes called *universal wastes.* Universal wastes include certain batteries, certain pesticides, and mercury thermostats. Pesticides designated as universal wastes include (1) recalled pesticides that are stocks of a suspended or canceled pesticide and part of a voluntary or mandatory recall under FIFRA §19(b); (2) recalled pesticides that are stocks of a suspended or canceled pesticide, or a pesticide that is not in compliance with FIFRA, that are part of a voluntary recall [see FIFRA §19(b)(2)] by the registrant; and (3) stocks of other unused pesticide products that are collected and managed as part of a waste pesticide collection program.

  The Universal Waste rule is *optional* for states/tribe to adopt. In those states/tribes that have not adopted the Universal Waste rule, these wastes must be disposed of in accordance with the hazardous (or acutely hazardous) waste requirements (see 40 CFR Part 262).

- ***Exemption for Small Quantities of Used Oil***. Under 40 CFR §279.20, agricultural establishments that generate an average of 25 gallons or less of used oil per month over a calendar year from vehicles or machinery used on the establishment are not subject to the requirements of 40 CFR Part 279.

- ***Exemption for "Farm Tanks" and Tanks of 110 Gallons or Less***. Under the underground storage tank (UST) regulations (RCRA Subtitle I, 40 CFR §280.12), "farm tanks" of 1,100 gallons or less capacity used for storing motor fuel for non-commercial purposes are not regulated as underground storage tanks. *"Farm tanks"* include tanks located on a tract of land devoted to the production of crops or raising animals (including fish) and associated residences and improvements. Also under 40 CFR §280.10, the UST program does not apply to UST systems of 110 gallons or less capacity, or that contain a *de minimis* concentration of a regulated substance.

  Even with the above exemptions, keep in mind that many agricultural establishments may be subject to the UST program (40 CFR Part 280). The UST regulations apply to facilities that store either petroleum products or hazardous substances (except hazardous wastes) identified under CERCLA. UST regulations address design standards, leak detection,

operating practices, response to releases, financial responsibility for releases, and closure standards.

Comprehensive Environmental Response, Compensation, and Liability Act

Under CERCLA, there are a limited number of statutory and regulatory requirements that potentially affect agricultural businesses. The key provisions are summarized below:

- **Emergency Release Notification Requirements**. Under CERCLA §103(a), facilities are required to notify the National Response Center about any release of a CERCLA hazardous substance in quantities equal to or greater than its reportable quantity (RQ). Releases include discharges into the air, soil, surface water, or groundwater. Any release at or above the RQ must be reported regardless of whether there is a potential for offsite exposure.

  - ***Hazardous Substances.*** The term "hazardous substance" is defined in CERCLA §101(14) and these substances (more than 700) are listed at 40 CFR Part 302, Table 302.4. Several agricultural chemicals are on the CERCLA hazardous substance list, including many pesticides, anhydrous ammonia, and ethylene glycol.

  - ***Reportable Quantities***. For each hazardous substance, EPA has designated a RQ of 1, 10, 100, 1,000, or 5,000 pounds. RQs are listed in 40 CFR Part 355, Appendices A and B and 40 CFR Part 302, Table 302.4.

  - ***When No Notification is Required***. There are several types of releases that are excluded from the requirements of CERCLA release notification. Two of these releases, excluded under CERCLA §§101(22) and 103(e), include the normal application of fertilizer and the application of pesticide products registered under FIFRA. *Keep in mind that spills, leaks, or other accidental or unintended releases of fertilizers and pesticides are subject to the reporting requirements.*

- **Facility Notification and Recordkeeping Requirements - Exemption for Agricultural Producers**. Under CERCLA §§103(c) and (d), certain facilities must notify EPA of their existence and the owners/operators must keep records. However, CERCLA §103(e) exempts agricultural

producers who store and handle FIFRA-registered pesticides from the facility notification and recordkeeping requirements. CERCLA does not define the term *agricultural producer*.

- **Liability for Damages**. Under CERCLA §107(a), an owner/operator of a facility that has CERCLA hazardous substances onsite may be liable for cleanup costs, response costs, and natural resource damages associated with a release or threatened release of hazardous substances. Agricultural establishments are potentially liable under this section, and that liability extends to past practices.

Emergency Planning and Community Right-to-Know Act

A summary of the potential applicability of specific sections of EPCRA on the agricultural sector follows below.

- **Emergency Planning and Notification**. Under EPCRA §302, owners or operators of any facility, including agricultural establishments, that have *extremely hazardous substances* (40 CFR Part 355 Appendices A and B) present in excess of the *threshold planning quantity* must notify in writing their state emergency response commission (SERC) and their local emergency planning committee (LEPC) that they are subject to EPCRA planning requirements. Under EPCRA §303, they must also notify the LEPC of the name of a person at their facility whom the LEPC may contact in regard to planning issues related to these extremely hazardous substances. They must also inform the LEPC promptly of any relevant changes, and when requested, must provide information to the LEPC necessary for emergency planning.

  Ammonia, several agricultural pesticides, and certain fuels are included on the list of extremely hazardous substances found in 40 CFR Part 355 Appendices A and B. If a listed substance is a solid, two different planning quantities are listed (e.g., 500 lbs/10,000 lbs). The smaller amount (e.g., 500 lbs.) applies if the substance is in powder form, such as a soluble or wettable powder, or if it is in solution or molten form. The larger quantity (10,000 lbs.) applies for most other forms of the substance. If the extremely hazardous substance is part of a mixture or solution, then the amount is calculated by multiplying its percent by weight times the total weight of the mixture or solution. If the percent by weight is less than one percent, the calculation is not required (40 CFR Part 355.30).

- Ammonia -- The quantity of anhydrous ammonia that triggers the planning requirement is 500 pounds.

- Pesticides -- Examples of pesticides on the list with the quantity in pounds that triggers the planning requirement include: ethion (1,000), nicotine (100), dichlorvos (1,000), parathion (100), chlordane (1,000), methyl bromide (1,000), ethylene oxide (1,000), fenitrothion (500), phorate (10), zinc phosphide (500), aluminum phosphide (500), terbufos (100), phosphamidon (100), demeton (500), ethoprop (1,000), and disulfoton (500).

- Solid Pesticides -- Examples of pesticides with dual quantities that trigger the planning requirements include: coumaphos (100/10,000), strychnine (100/10,000), dimethoate (500/10,000), warfarin (500/10,000), azinphos-methyl (10/10,000), methyl parathion (100/10,000), phosmet (10/10,000), methidathion (500/10,000), carbofuran (10/10,000), paraquat (10/10,000), methiocarb (500/10,000), methamidophos (100/10,000), methomyl (500/10,000), fenamiphos (10/10,000), and oxamyl (100/10,000).

- **§304 Emergency Release Notification**. Under 40 CFR 355, facilities must *immediately* notify the SERC and LEPC of releases of EPCRA extremely hazardous substances and CERCLA hazardous substances when the release equals or exceeds the reportable quantity within a 24-hour period and has the *potential* for offsite exposure. There are two notifications required: the initial notification and the written followup notification.

  Exemption for Substances Used in Agricultural Operations. Only facilities that produce, use or store *hazardous chemicals* are subject to EPCRA release reporting. EPCRA §311(e) excludes from the definition of *hazardous chemicals* those substances used in routine agricultural operations. The exemption covers fertilizers and pesticides used in routine agricultural operations and fuels for operating farm equipment (including to transport crops to market). If all the hazardous chemicals present at the facility do not fall within this exemption, the facility must report all releases of any EPCRA extremely hazardous substance or CERCLA hazardous substance. Additionally, spills, leaks, or other accidental or unintended releases of fertilizers and pesticides are subject to the EPCRA release reporting requirements.

- **§311 and §312 Hazardous Chemical Inventory and Reporting**. Under EPCRA §311 and §312, facilities must inventory the hazardous chemicals present onsite in amounts equal to or in excess of the threshold planning quantities, and meet two reporting requirements:

  – A one-time notification of the presence of hazardous chemicals onsite in excess of threshold levels (EPCRA §311) to the SERC, LEPC, and the local fire department; and

  – An annual notification (Tier I or Tier II report) to the SERC, LEPC, and the local fire department detailing the locations and hazards associated with the hazardous chemicals found on facility grounds (EPCRA §312).

  Exemption for Substances Used in Agricultural Operations. As mentioned above, the term "hazardous chemical," as defined in EPCRA §311(e), *excludes* substances used in routine agricultural operations.

Clean Air Act

Agriculture-related industries generally do not include those industry sectors considered to be major sources of air pollution. Nevertheless, some agriculture-related activities are potentially subject to regulation under the CAA. The provisions identified below summarize the CAA requirements applicable to certain agriculture-related activities:

- **Risk Management Program.** Under §112(r) of the Clean Air Act, EPA has promulgated the Risk Management Program Rule. The rule's main goals are to prevent accidental releases of regulated substances and to reduce the severity of those releases that do occur by requiring facilities to develop risk management programs. A facility's risk management program must incorporate three elements: a hazard assessment, a prevention program, and an emergency response program. These programs are to be summarized in a risk management plan (RMP) that will be made available to state and local government agencies and the public.

  Under 40 CFR Part 68, facilities that have more than the threshold quantity of any of the listed regulated substances in a single process are required to comply with the regulation. *Process* means any regulated activity involving a regulated substance, including manufacturing, storing, distributing, or handling a regulated substance or using it in any other way. Any group of interconnected vessels (including piping), or separate vessels located close

enough together to be involved in a single accident, are considered a single process. Transportation is not included.

Listed regulated substances are acutely toxic substances, flammable gases, volatile liquids, and highly explosive substances listed by EPA in the Risk Management Program rule. The *threshold quantity* is the amount of a regulated substance that triggers the development of a RMP. The list of regulated substances and their corresponding threshold quantities are found at 40 CFR Part 68. Examples of threshold quantities of listed regulated substances include: formaldehyde -- 15,000 pounds; ethylene oxide -- 10,000 pounds; methyl isocyanate -- 10,000 pounds; anhydrous ammonia -- 10,000 pounds; and mixtures containing ammonia in a concentration of 20 percent or greater -- 20,000 pounds.

Exception: Ammonia that farmers are holding for use as fertilizer is not a regulated substance under the risk management program. Farmers are not responsible for preparing a risk management plan if ammonia held for use as a fertilizer is the only listed regulated substance that they have in more than threshold quantities. However, ammonia that is on a farm for any other use, such as for distribution or as a coolant/refrigerant, is not exempt.

Three program levels. The risk management planning regulation (40 CFR Part 68) defines the activities facilities must undertake to address the risks posed by regulated substances in covered processes. To ensure that individual processes are subject to appropriate requirements that match their size and the risks they may pose, EPA has classified them into 3 categories ("programs"):

– **Program 1** requirements apply to processes for which a worst-case release, as evaluated in the hazard assessment, would not affect the public. These are processes that have **not** had an accidental release that caused serious offsite consequences.

– **Program 2** requirements apply to less complex operations that do **not** involve chemical processing.

– **Program 3** requirements apply to higher risk, complex chemical processing operations and to processes already subject to the **OSHA Process Safety Management Standard (29 CFR 1910.119)**.

Risk Management Planning. Facilities with more than a threshold quantity of any of the 140 regulated substances in a single process are required to develop a risk management program and to summarize their program in a risk management plan (RMP). A facility subject to the requirements were required to submit a registration and RMP by June 21, 1999, or whenever it first exceeds the threshold for a listed regulated substance after that date.

All facilities with processes in Program 1 must carry out the following elements of risk management planning:

- An offsite consequence analysis that evaluates specific potential release scenarios, including worst-case and alternative scenarios.
- A five-year history of certain accidental releases of regulated substances from covered processes.
- A risk management plan, revised at least once every five years, that describes and documents these activities for all covered processes.

Facilities with processes in Programs 2 and 3 must also address each of the following elements:

- An integrated prevention program to manage risk. The prevention program will include identification of hazards, written operating procedures, training, maintenance, and accident investigation.
- An emergency response program.
- An overall management system to put these program elements into effect.

- **National Ambient Air Quality Standards (NAAQS)/SIPS**. Under the CAA §10, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. If the applicable SIP imposes requirements on an agricultural establishment, that facility must comply with the SIP. The most likely pollutant of concern with respect to agriculture-related businesses is particulate matter.

Federal Insecticide, Fungicide, and Rodenticide Act

For agricultural producers, FIFRA is the environmental statute that most significantly impacts day-to-day operations of pesticide use. It also imposes administrative requirements on pesticide users, including agricultural producers. A

summary of major provisions applicable to agricultural producers is provided below.

- **Use restrictions:** The pesticide product label is information printed on or attached to the pesticide container. Users are legally required to follow the label. Labeling is the pesticide product label and other accompanying materials which contain directions that pesticide users are legally required to follow. Under FIFRA §12, each pesticide must be used only in a way that is consistent with its labeling.

  - As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

  - It is against the law (Endangered Species Act) to harm an endangered species. Harm includes not only acts that directly injure or kill the protected species, but also significant habitat modification or degradation that disrupts breeding, feeding, or sheltering. Pesticide users must comply with any pesticide labeling restrictions or requirements that concern the protection of endangered species or their habitats.

- **Tolerances and Exemptions** A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR.163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

  To avoid being responsible for products being over tolerance, users must be particularly careful to comply with the label instructions concerning application rate and minimum days between pesticide application and harvest (i.e., preharvest interval), slaughter, freshening, or grazing.

- **Worker Protection Standard (WPS) Requirements for Users**. The WPS for Agricultural Pesticides (40 CFR Parts 156 and 170) covers

pesticides that are used in the commercial production of agricultural plants on farms, forests, nurseries, and greenhouses. The WPS requires pesticide users to take steps to reduce the risk of pesticide-related illness and injury if they or their employees may be exposed to pesticides used in the commercial production of agricultural plants.

- **Cancellation and Suspension** EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

  In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

  When EPA believes and emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order that makes the suspension immediately effective.

Toxic Substances Control Act

TSCA has a limited impact on the agricultural sector. TSCA §3, Definitions, specifies that the term chemical substance means any organic or inorganic substance of a particular molecular identity. The definition also states, as declared at subsection (2)(B)(ii), that such term does not include any pesticide (as defined in FIFRA) when manufactured, processed, or distributed in commerce for use as a pesticide. Since the majority of potentially hazardous substances used by agricultural producers are pesticides, they are regulated under FIFRA. Regulation of hazardous substances under other authorities is part of TSCA's overall scheme which allows EPA to decline to regulate a chemical under TSCA if other federal regulatory authorities (e.g., FIFRA) are sufficiently addressing the risks posed from those substances.

- **Asbestos and Asbestos-Containing Material**. Under TSCA §6 and 40 CFR Part 61, Subpart M, EPA regulates the renovation/demolition activities, notification, work practices and removal, and disposal of asbestos-containing material (ACM). ACM should be carefully monitored;

however, the mere presence of asbestos in a building is not considered hazardous. ACM that becomes damaged, however, may pose a health risk since it may release asbestos fibers over time. If a material is suspected of containing asbestos and it is more than slightly damaged, or if changes need to be made to a building that might disturb it, repair or removal of the ACM by a professional is needed.

- **Asbestos Brake Pads**. Facilities that repair their own brakes should be aware of asbestos requirements. Asbestos brake pads must be removed using appropriate control measures so that no visible emissions of asbestos will be discharged to the outside air. These measures can include one of the following: (1) wetting that is generally done through the use of a brake washing solvent bath, such as those provided by a service; (2) vacuuming that is usually performed with a commercial brake vacuum specifically designed for use during brake pad changing or pad re-lining operations; or (3) combination of wetting and vacuuming.

  Asbestos brake pads and wastes must be managed by: (1) labeling equipment, (2) properly disposing of spent solvent, (3) properly disposing of used vacuum filters, and (4) sealing used brake pads. The containers or wrapped packages must be labeled using warning labels as specified by OSHA [29 CFR 1910.001 (j) (2) or 1926.58 (k)(2)(iii)].
  Asbestos waste must be disposed of as soon as practical at an EPA-approved disposal site. The asbestos containers must be labeled with the name and location of the waste generator. Vehicles used to transport the asbestos must be clearly labeled during loading and unloading. The waste shipment records must be maintained (40 CFR 61.150) so that the asbestos shipment can be tracked and substantiated.

- **Polychlorinated Biphenyls (PCBs)**. PCBs were widely used in electrical equipment manufactured from 1932 to 1978. Types of equipment potentially containing PCBs include transformers and their bushings, capacitors, reclosers, regulators, electric light ballasts, and oil switches. Any equipment containing PCBs in their dielectric fluid at concentrations of greater than 50 ppm are subject to the PCB requirements.

  Under TSCA §6 and 40 CFR Part 761, facilities must ensure through activities related to the management of PCBs (e.g., inspections for leaks, proper storage) that human food or animal feed are not exposed to PCBs. While the regulations do not establish a specific distance limit, any item containing PCBs is considered to pose an unacceptable exposure risk to

food or feed if PCBs released in any form have the potential to reach/ contaminate food or feed.

- **Lead**. Approximately 1.7 million children have blood-lead levels high enough to raise health concerns. Studies suggest that lead exposure from deteriorated residential lead-based paint, contaminated soil, and lead in dust are among the major existing sources of lead exposure among children in the U.S.

  Section 1018 of the Residential Lead-Based Paint Hazard Reduction Act of 1992 directs EPA and the Department of Housing and Urban Development (HUD) to jointly issue regulations requiring disclosure of known lead-based paint and/or lead-based paint hazards by persons selling or leasing housing constructed before the phaseout of residential lead-based paint use in 1978. Under that authority, EPA and HUD jointly issued on March 6, 1996, regulations titled *Lead; Requirements for Disclosure of Known Lead-Based Paint and/or Lead-Based Paint Hazards in Housing* (40 CFR Part 35 and 40 CFR Part 745). In these regulations, EPA and HUD established requirements for sellers/lessors of residential housing built before 1978.

  Pre-Renovation Lead Information Rule. If conducted improperly, renovations in housing with lead-based paint can create serious health hazards to workers and occupants by releasing large amounts of lead dust and debris. Under TSCA §406 and through a rule published on June 1, 1998 entitled *Lead; Requirements for Hazard Education Before Renovation of Target Housing* (40 CFR Part 745), EPA required the distribution of lead hazard information (i.e., EPA-developed pamphlet) prior to professional renovations on residential housing built before 1978.

IV.C. Proposed and Pending Regulations

Coastal Zone Act Reauthorization Amendments of 1990

Implementation of Management Measures. Under Section 6217, states/tribes must fully implement the management measures in their Coastal Nonpoint Pollution Control Programs by January 2004. States/tribes are required to perform effectiveness monitoring between 2004 and 2006 and implement other measures between 2006 and 2009.

Safe Drinking Water Act

Management of Class V Wells. EPA plans to propose additional requirements addressing the environmental risks posed by the highest risk Class V wells. This rulemaking potentially affects agricultural operations that use industrial and commercial disposal wells and large capacity cesspools.

Federal Insecticide, Fungicide, and Rodenticide Act

Pesticide Management and Disposal: Proposed Rule - issued on May 5, 1993 (FR26857). The regulations for this rule will be found in the Code of Federal Regulations (CFR) at 40 CFR Part 165 - Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticides Containers. This final rule will:

- Describe procedures for voluntary and mandatory recall actions.
- Establish criteria for acceptable storage and disposal plans which registrants may submit to EPA to become eligible for reimbursement of storage costs.
- Establish procedures for the indemnification of owners of suspended and canceled pesticides.
- Amend the Agency's responsibility for accepting for disposal suspended and canceled pesticides.

THIS PAGE LEFT INTENTIONALLY BLANK

V. COMPLIANCE AND ENFORCEMENT HISTORY

V.A. Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match air, water, waste, toxics/pesticides, EPCRA, Toxics Release Inventory (TRI), and enforcement docket records for a given facility and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, EPA is developing sector-specific measures of success for compliance assistance efforts.

V.B. Compliance and Enforcement Profile Description

This section uses inspection, violation, and enforcement data from the IDEA system to provide information about the historical compliance and enforcement activity of this sector. While other sector notebooks have used Standard Industrial Classification (SIC) data from the Toxics Release Inventory System (TRIS) to define their data sampling universes, none of the SIC codes associated with the crop production sectors identifies facilities that report to the TRI program. As such, sector-defining data have been provided from EPA data systems linked to EPA's Facility Indexing System (FINDS), which

Note: Many of the previously published sector notebooks contained a chapter titled "Chemical Release and Transfer Profile." The information and data for that chapter were taken primarily from EPA's Toxic Release Inventory (TRI). Because the industries discussed in this notebook do not, in general, directly report to TRI, that chapter has not been included in this sector notebook.

tracks facilities in all media databases. This section does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census. With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Before presenting the data, the next section defines general terms and the column heads used in the data tables. The data represent a retrospective summary of inspections and enforcement actions and solely reflect EPA, state, and local compliance assurance activities that have been entered into EPA databases. To identify trends, EPA ran two data queries, one for five calendar years (March 7, 1992 to March 6, 1997) and the other for a twelve-month period (March 7, 1996 to March 6, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and state's efforts within each media program. The presented data illustrate the variations across EPA regions for certain sectors.[1] This variation may be attributable to state/local data entry variation, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

[1] EPA Regions are as follows: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) - assigns a common facility number to EPA single-media permit records, establishing a linkage capability to the permit data. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) **-** is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, this creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are AFS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCBD (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS. IDEA also contains information from outside sources, such as Dun and Bradstreet (DUN) and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in this section were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search - based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, or industries in which only a very small fraction of facilities report to TRI, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected - indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections - measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections - provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities With One or More Enforcement Actions - expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal state actions. A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions - describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (i.e., a facility with 3 enforcement actions counts as 3).

State Lead Actions - shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions - shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from state agencies. Many of these actions result from coordinated or joint federal/state efforts.

Enforcement to Inspection Rate - is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. The ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified - expresses the percentage of inspected facilities having a violation identified in one of the following data

categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections - four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

V.C. Compliance History for the Agricultural Production Industries: Crops, Greenhouses/Nurseries, and Forestry

Exhibit 23 provides an overview of the reported compliance and enforcement data for the agricultural production industries over the past 5 years (March 1992 to March 1997). These data are also broken out by EPA regions thereby permitting geographical comparisons.

Note: It should be noted that the data presented in this section represent federal enforcement activity only. Enforcement activity conducted at the state level is not included in this analysis.

A few points evident from the data are listed below. It should also be noted that agriculture crop production (SIC code 01) and forestry (SIC code 08) are presented separately in the exhibits.

- As shown, of the 6,688 facilities identified through IDEA with crop production NAICS codes, nearly half (3,046) were inspected in over the 5-year period. The total number of inspections over the same 5 years was 10,453, which means that, on average, each facility was subjected to nearly 3.5 inspections over the 5 years.

- Region 7 has the most crop production facilities with 2,391 and has conducted the most inspections (3,180). Similarly, Region 5 has the second most facilities and has conducted the second most inspections. Inspections in these regions comprise more than half (57%) of all inspections conducted.

- The 10,453 inspections conducted nationwide have resulted in 262 enforcement actions, which results in an enforcement-to-inspection

rate of 0.03. This means that for every 100 inspections conducted, there are approximately 3 resulting enforcement actions.

- The average enforcement-to-inspection rate across the regions ranged from 0.01 in Region 5 to 0.08 in Regions 1 and 2.

Exhibit 24 provides an overview of the reported compliance and enforcement data for forestry SIC codes over the 5-year period by EPA region.

- Of the 97 facilities identified, approximately 25 percent (24 facilities) were inspected in the 5-year period.
- The 68 inspections conducted nationwide have resulted in 10 enforcement actions, which results in an enforcement-to-inspection rate of 0.15.

Exhibit 23. Five-Year Enforcement and Compliance Summary for the Agricultural Crop Production Industry									
A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	156	41	148	63	8	12	67%	33%	0.08
II	119	47	958	7	19	80	91%	9%	0.08
III	343	167	812	25	10	20	95%	5%	0.02
IV	809	283	1,212	40	18	28	86%	14%	0.02
V	1,491	930	2,816	32	14	18	67%	33%	0.01
VI	524	128	405	78	18	30	63%	37%	0.07
VII	2,391	1,113	3,180	45	37	54	41%	59%	0.02
VIII	142	53	129	66	3	3	0%	100%	0.02
IX	298	164	587	30	8	11	82%	18%	0.02
X	415	120	206	121	6	6	67%	33%	0.03
TOTAL	6,688	3,046	10,453	38	141	262	73%	27%	0.03

Exhibit 24: Five-Year Enforcement and Compliance Summary for the Forestry Production Industry									
A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	3	1	1	180	1	1	100%	0%	1.00
II	1	1	1	60	0	0	--	--	--
III	3	2	12	15	0	0	--	--	--
IV	13	4	4	195	1	1	0%	100%	0.25
V	4	2	22	11	1	3	100%	0%	0.14
VI	8	3	10	48	1	3	0%	100%	0.30
VII	1	1	3	20	0	0	--	--	--
VIII	2	0	0	--	0	0	--	--	--
IX	6	1	2	180	0	0	--	--	--
X	56	9	13	258	1	2	100%	0%	0.15
TOTAL	97	24	68	86	5	10	60%	40%	0.15

Comparison of Enforcement Activity Between Selected Industries

Exhibits 25 and 26 provide both the 5-year and 1-year enforcement and compliance data for most of the industries covered by the sector notebooks. These data allow the reader to compare the enforcement and compliance history of the sectors and identify trends across sectors and over the 5-year period.

- Of the industries presented, the crop production sector has the second most identified facilities with 6,688; it also has the second highest number of facilities inspected (3,046) over the 5-year period. The enforcement-to-inspection rate of 0.03 was the second lowest among all sectors.

- Forestry has the second fewest number of facilities (97) among all sectors and the fewest number of facilities inspected (24). Its enforcement-to-inspection rate of 0.15 is the second highest, next to petroleum refining (0.25).

In Exhibit 26, when compared to all sectors over the last year, the crop production sector had the fifth most facilities inspected (1,012) and the fourth most inspections conducted (1,459). The enforcement-to-inspection rate of 0.02 for the crop production sector was among the lowest rates across all sectors. From March 1996 - March 1997, forestry had the fewest number of facilities inspected and the lowest number of inspections conducted.

Exhibits 27 and 28 provide a more in-depth comparison between the crop production and forestry sectors and others by organizing inspection and enforcement data by environmental statute. Exhibit 27 provides inspection and enforcement data over the 5-year period, while Exhibit 28 provides data for the March 1996 - March 1997 only.

As shown in Exhibit 27, over the 5-year period, nearly three-quarters of all inspections conducted at crop production facilities were under the Clean Air Act. However, the CAA accounts for only 35 percent of all enforcement actions. The enforcement actions are spread out across the CAA (35%), CWA (23%), and RCRA (25%) with FIFRA/TSCA/EPCRA/Other having the lowest percentage of enforcement actions (17%). For forestry, more than half of all inspections and exactly half of all enforcement actions have come under RCRA.

For March 1996 - March 1997 (see Exhibit 28), again CAA inspections account for nearly three-quarters of all inspections for the crop production sectors. And, similarly to the 5-year history, enforcement actions are fairly evenly disbursed among the CAA (31%), CWA (34%), and RCRA (28%). It

should be noted that 7 percent of all enforcement actions were taken under the FIFRA/TSCA/EPCRA/Other category although no inspections were conducted within that category. This number is possible because in many EPA regions, media inspectors are being trained to examine the facility from a multimedia viewpoint. As a result, these actions may originate from the media inspections. Regarding the forestry industry, 83 percent of all inspections were conducted under the RCRA program. However, no enforcement actions were taken based on those inspections. Two-thirds of all enforcement actions were taken under the FIFRA/TSCA/EPCRA/Other category, although no inspections were conducted under those programs (see above note).

Exhibit 25. Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Avg. Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Livestock	1,001	205	600	100	20	31	84%	16%	0.05
Crop Production	**6,688**	**3,046**	**10,453**	**38**	**141**	**262**	**73%**	**27%**	**0.03**
Forestry	**97**	**24**	**68**	**86**	**5**	**10**	**60%**	**40%**	**0.15**
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass & Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Aerospace	237	184	1,206	12	67	127	75%	25%	0.10
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Exhibit 26. One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Livestock	1001	107	146	22	21%	2	2%	2	0.01
Crop Production	**6688**	**1012**	**1459**	**866**	**86%**	**23**	**2%**	**29**	**0.02**
Forestry	**97**	**8**	**12**	**7**	**88%**	**2**	**25%**	**3**	**0.25**
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Aerospace	237	119	216	105	88%	8	7%	11	0.05
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*

Exhibit 27. Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Livestock	205	600	31	38%	26%	57%	65%	3%	6%	0%	3%
Crop Production	**3,046**	**10,453**	**262**	**72%**	**35%**	**11%**	**23%**	**13%**	**25%**	**3%**	**17%**
Forestry	**24**	**68**	**10**	**13%**	**30%**	**25%**	**0%**	**59%**	**50%**	**3%**	**20%**
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Aerospace	184	1,206	127	34%	38%	10%	11%	54%	42%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

Exhibit 28. One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Livestock	107	146	2	48%	0%	51%	100%	1%	0%	0%	0%
Crop Production	**1012**	**1459**	**29**	**71%**	**31%**	**13%**	**34%**	**16%**	**28%**	**0%**	**7%**
Forestry	**8**	**12**	**3**	**8%**	**33%**	**8%**	**0%**	**83%**	**0%**	**0%**	**67%**
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins & Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Aerospace	119	216	11	37%	36%	7%	0%	54%	55%	1%	9%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

VI. REVIEW OF MAJOR LEGAL ACTIONS

This section provides summary information about major cases that have affected the this sector, and a list of Supplemental Environmental Projects (SEPs).

Review of Major Cases

The following cases are examples of EPA's enforcement against the agricultural production industries of crops, greenhouses/nurseries, and forestry.

Cumberland Farms, Inc. In September 1996, a District Court entered a consent decree between the U.S. and Cumberland Farms, Inc., which resolves a long standing wetlands enforcement action against Cumberland Farms, Inc., for its unpermitted filling of 180 acres of wetlands in violation of the Clean Water Act between 1977 and 1990 in Halifax and Hanson, Massachusetts. Under the consent decree, Cumberland is required to deed two undeveloped tracts of land, totaling 225 acres, to the Massachusetts Division of Fisheries and Wildlife for permanent conservation. In addition, the company will establish a 30-acre wildlife and wetlands corridor on the most seriously damaged site and pay a civil $50,000 penalty. This settlement, along with others, will preserve a total of 490 acres of undeveloped habitat in the same watershed as the violations. This represents the largest permanent preservation of habitat arising from a federal enforcement in New England.

U.S. v. Tropical Fruit. Tropical Fruit, S.E., in Guayanilla, Puerto Rico, operates a plantation where it grows mangoes, bananas, and other fruits. On December 20, 1996, Region 2 issued an administrative order under CERCLA 106(a) to Tropical Fruit, S.E., and its three individual partners of that company (Avshalom Lubin, Cesar Otero Acevedo, and Pedro Toledo Gonzalez) for application of pesticides using a high pressure applicator that produced a cloud which sometimes would drift into the adjacent residential community, which is composed of minority and low income residents. The CERCLA order requires that the respondents immediately cease and desist from spraying pesticides, fungicides, and any other materials that contain hazardous substances in such a manner that these substances might drift or otherwise migrate beyond the boundaries of the farm.

Region 2 also issued an administrative complaint for violations of the Worker Protection Standard for agricultural workers under FIFRA. The complaint cited Tropical Fruit's failure to post warning signs during and after application, as well as its failure to maintain a decontamination area and a central bulletin board with pesticide safety information.

On March 26, 1997, DOJ (acting on EPA's behalf) filed a complaint against Tropical Fruit seeking an injunction requiring the firm and its partners to comply with EPA's CERCLA order and all applicable FIFRA requirements. Three of the pesticides routinely used by Tropical Fruits on its mango trees are not registered for use on mangoes; their use in this manner is in violation of FIFRA. The judicial complaint also sought penalties for violations of the CERCLA order since its issuance. Also on March 26, 1997, the court signed an interim consent order requiring Tropical Fruit to modify its pesticide application procedures to prevent these substances from drifting into the adjacent residential community. The order also requires Tropical Fruit to better protect its workers by providing extensive training, protective clothing, respirators, and decontamination equipment. Subsequently on May 21, 1997, EPA documented further violations of the CERCLA administrative order and the judicial interim consent order. On August 22, 1997, Tropical Fruit paid $10,000 in stipulated penalties for those violations.

Region 2 also has documented additional FIFRA violations by Tropical Fruit, which included the illegal importation of Cultar, an unregistered pesticide from the Middle East. In addition, the region has documented violations of RCRA UST regulations, as well as violations of CWA §404 and the associated regulations regarding discharge of dredged or fill materials into wetlands. EPA anticipates that all of these violations will be subject to further enforcement action.

Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility. Information on SEPs can be accessed via the internet at http://www.epa.gov/oeca/sep.

There was one SEP at an agricultural crop producing facility. This SEP was negotiated with Franklin Mushroom Farms, Incorporated (Franklin Farms) of Southington, CT. The complaint alleged that Franklin Farms illegally discharged pollutants to a nearby river in violation of their NPDES Permit. As part of a settlement, Franklin Farms agreed to a SEP in which they would institute water recycling/conservation methods to reduce overall pollutant loading to the river. The cost of instituting these methods was $89,900 at the time of the settlement. Franklin Farms also was required to pay a penalty of $75,000. Details on this SEP can be found by accessing http://es.epa.gov/oeca/sep/searchsep.html, selecting '01 Agriculture - Crop Production' in the *Industrial Sector of Violation* field, and choosing the *Submit Search* button.

VII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VII.A. Sector-Related Environmental Programs and Activities

There are several federal programs available to the agricultural community to assist agricultural producers in complying with environmental regulations and reducing pollution. The following examples represent some industry initiatives that promote compliance or assess methods to reduce environmental contamination.

National Agriculture Compliance Assistance Center

The U.S. Environmental Protection Agency (EPA), with the support of the Department of Agriculture (USDA), has developed a national Agriculture Compliance Assistance Center (Ag Center) to provide a base for "first-stop shopping" for the agricultural community -- one place for the development of comprehensive, easy-to-understand information about approaches to compliance that are both environmentally protective and agriculturally sound. The Ag Center, a program offered by EPA's Office of Compliance, seeks to increase compliance by helping the agricultural community identify flexible, common sense ways to comply with the many environmental requirements that affect their business. Initial efforts will focus on providing information about EPA's requirements. The Ag Center will rely heavily on existing sources of agricultural information and established distribution mechanisms. The Ag Center is designed so growers, livestock producers, other agribusinesses, and agricultural information/education providers can access its resources easily -- through telephone, fax, mail, and Internet. The Ag Center website can be accessed at http://www.epa.gov/oeca/ag.

Unified National Strategy for Animal Feeding Operations

As part of President Clinton's Clean Water Action Plan (CWAP), a USDA-EPA unified national strategy has been developed to minimize the water quality and public health impacts (e.g., nutrient loading, fish kills, odors) of animal feeding operations (AFOs). USDA and EPA's goal is for AFO owners and operators to take actions to minimize water pollution from confinement facilities and land application of manure. To accomplish this goal, this Strategy is based on a national performance expectation that all AFOs should

develop and implement technically sound, economically feasible, and site-specific Comprehensive Nutrient Management Plans (CNMPs) to minimize impacts on water quality and public health.

CNMPs identify actions or priorities that will be followed to meet clearly defined nutrient management goals at an agricultural operation. They should address, as necessary, feed management, manure handling and storage, land application of manure, land management, recordkeeping, and other utilization options. While nutrients are often the major pollutants of concern, the plan should address risks from other pollutants, such as pathogens, to minimize water quality and public health impacts from AFOs. CNMPs should be site-specific and be developed and implemented to address the goals and needs of the individual owner/operator, as well as the conditions on the farm. USDA and EPA issued a the final draft of this Strategy in March 1999. For more information, the complete unified national strategy can be accessed at http://www.epa.gov/owm/finafost.htm.

VII.B. EPA Programs and Activities

Section 319 Nonpoint Source Management Program

In 1987, Congress amended the Clean Water Act (CWA) to establish the §319 Nonpoint Source Management Program in recognition of the need for greater federal leadership to help focus state and local nonpoint source efforts. Under §319, states, territories, and Indian tribes receive grant money to support a wide variety of activities, including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects. For more information about the Clean Water Act §319 Program, refer to EPA's Office of Water website at http://www.epa.gov/OWOW/NPS/sec319.html.

Clean Lakes Program

EPA's Clean Lakes Program supports a variety of lake management activities including classification, assessment, study, and restoration of lakes. The program, authorized in §314 of the Clean Water Act, was established to provide technical and financial assistance to states/tribes for restoring the quality of publicly owned lakes. The Clean Lakes Program has funded approximately $145 million for grant activities since 1976 to address lake problems, but there have been no appropriations for the program since 1994. EPA has not requested funds for the Clean Lakes Program in recent years, but has encouraged states to use §319 funds to fund "eligible activities that might have been funded in previous years under Section 314." Information on the Clean Lakes Program is available at the following Internet site: http://www.epa.gov/owow/lakes/cllkspgm.html.

National Estuary Program

EPA's National Estuary Program is a national demonstration program, authorized in §320 of the Clean Water Act, that uses a comprehensive watershed management approach to address water quality and habitat problems in 17 estuaries. Nonpoint source pollution is a major contributor of contaminants in the estuary and coastal waters around the country. In this program, EPA and states/tribes develop conservation and management plans that recommend priority corrective actions to restore estuarine water quality, fish populations, and other designated uses of the waters. Information on the National Estuary Program is available at the following Internet site: http://www.epa.gov/owowwtr1/estuaries/nep.html or by contacting the National Estuary Program Office at (202) 260-1952.

Chesapeake Bay Program and The Great Lakes National Program

EPA's Chesapeake Bay Program and the Great Lakes National Program focus substantial resources on understanding the extent of nonpoint source pollution problems in their respective watersheds and supporting State implementation of non-point source pollution controls. Since 1984, the Chesapeake Bay Program, in particular, has supported the implementation of a substantial amount of animal waste management practices through State cost share programs funded jointly by the Bay States and EPA. Information on the Chesapeake Bay Program is available at http://www.epa.gov/owowwtr1/ecoplaces/part1/site2.html. Information on The Great Lakes National Program is available at http://www.epa.gov/glnpo/.

AgSTAR Program

The AgSTAR program is a voluntary program that promotes the use of profitable manure management systems that reduce pollution. The program, a component of President Clinton's Climate Action Plan, is based on a computer model that shows the economic value of capturing the methane naturally produced by manure.

AgSTAR, a joint program of EPA, USDA, and the Department of Energy, helps agricultural producers determine which methane recovery and use technologies will work best for them, and develops financing sources to help with start-up costs. By investing in these technologies, AgSTAR participants realize substantial returns through reduced electrical, gas, and oil bills, revenues from high quality manure by-products, and savings on manure management operational costs. Partners also reduce pollution associated with water resources, odors, and global warming. Information on AgSTAR is available at the following Internet site: http://yosemite.epa.gov/methane/home.nsf/pages/agstar.

Pesticide Environmental Stewardship Program

EPA's Pesticide Environmental Stewardship Program (PESP) is a voluntary program dedicated to protecting human health and preserving the environment by reducing the risks associated with pesticide use. The partnership is a key element of the program, which is sponsored by EPA, USDA, and FDA. Current partners include agricultural producers as well as non-agricultural interests. Partners in PESP volunteer to develop and implement a well designed pesticide management plan that will produce the safest and most effective way to use pesticides. In turn, EPA provides a liaison to assist the partner in developing comprehensive, achievable goals. Liaisons act as "customer service representatives" for EPA, providing the partner with access to information and personnel. EPA also promises to integrate the partners' stewardship plans into its agricultural policies and programs.

So far, agricultural producers have committed to a number of projects, including conducting more research into IPM techniques, developing computer prediction models for more precise pesticide applications, educating their members and the public regarding pesticide use, and working with equipment manufacturers to refine application techniques. Information on PESP is available at the following Internet site: http://www.pesp.org, or contact the PESP hotline at (800) 972-7717.

Endangered Species Protection Program

The Endangered Species Protection Program (ESPP) began in 1988. This program is largely voluntary at the present time and relies on cooperation between the U.S. Fish and Wildlife Service (FWS), EPA Regions, States, and pesticide users. EPA's Endangered Species Protection Program is designed to protect Federally-listed endangered and threatened species from exposure to pesticides. The program is intended to provide information concerning and regulation for the use of pesticides that may adversely affect the survival, reproduction and/or food supply of listed species. Due to labeling requirements, potential users will be informed prior to making a purchase that there may be local limitations on product use due to endangered species concerns. Information on the Endangered Species Protection Program is available at the following Internet site: http://www.epa.gov/oppfead1/endanger/index.htm.

Energy Star® Buildings and Green Lights® Partnership

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy-efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings— a strategy that optimizes whole-building energy-efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States

produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star® Buildings upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to $25 billion annually.

The more than 2,900 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. As of March 31, 1999, Energy Star®Buildings and Green Lights® Program participants are saving $775 million in energy bills with an annual savings of 31.75 kilowatt per square foot and annual cost savings of $0.47 per square foot. By joining, participants agree to upgrade 90 percent of their owned facilities with energy-efficient lighting and 50 percent of their owned facilities with whole-building upgrades, where profitable, over a seven-year period. Energy Star® participants first reduce their energy loads with the Green Lights® approach to building tune-ups, then focus on "right sizing" their heating and cooling equipment to match their new energy needs. EPA's Office of Air and Radiation is responsible for operating the Energy Star® Buildings and Green Lights® Program. (Contact: Energy Star Hotline, 1-888-STAR-YES (1-888-782-7937) or Maria Tikoff Vargas, Co-Director at (202) 564-9178 or visit the website at http://www.epa.gov/buildings.)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection, and the manufacturing and purchase of recycled products. As of 1998, the program had about 700 business, government, and institutional partners. Partners agree to identify and implement actions to reduce their solid wastes by setting waste reduction goals and providing EPA with yearly progress reports for a three-year period. EPA, in turn, provides partners with technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at (800) 372-9473 or Joanne Oxley, EPA Program Manager, (703) 308-0199.)

Climate Wise Program

In October 1993, President Clinton unveiled the Climate Change Action Plan (CCAP) in honor of the United States' commitment to reducing its greenhouse gas emissions to 1990 levels by the year 2000. Climate Wise, a project jointly sponsored by the U.S. Department of Energy and EPA, is one of the projects initiated under CCAP.

Climate Wise is a partnership between government and industry that offers companies a nonregulatory approach to reducing greenhouse gas emissions. Climate Wise state and local government "allies" work with U.S. industries to develop flexible, comprehensive strategies for achieving energy efficiency and pollution prevention. They help local business identify and implement projects that often require little capital investment, but promise a high rate of return. Companies that become Climate Wise partners receive technical assistance and financing information to help them develop and implement cost-effective changes. (Contact: Climate Wise Clearinghouse at (301) 230-4736 or visit the Climate Wise website at http://www.epa.gov/climatewise/allies.htm or http://www.epa.gov/climatewise/index.htm.)

VII.C. USDA Programs and Activities

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a USDA funded program (led by Natural Resources Conservation Service) that was established in the 1996 Farm Bill to provide a voluntary conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. EQIP embodies four of USDA's former conservation programs, including the Agricultural Conservation Program, the Water Quality Incentives Program, the Great Plains Conservation Program, and the Colorado River Basin Salinity Control Program.

EQIP offers 5 to 10 year contracts that provide *incentive payments* and *cost-sharing* for conservation practices called for in a site-specific conservation plan that is required for all EQIP activities. *Cost-sharing* may include up to 75 percent of the costs of certain conservation practices, such as grassed waterways, filter strips, manure management facilities, capping abandoned wells, and other practices. *Incentive payments* may be made to encourage land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management. These payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the program incentive.

EQIP has an authorized budget of $1.3 billion through the year 2002. It was funded for $174 million in 1999. Total cost-share and incentive payments are limited to $10,000 per person per year and $50,000 for the length of the contract. Eligibility is limited to persons who are engaged in livestock or agricultural production. Fifty percent of the funds must be spent on livestock production. The 1996 Farm Bill prohibits owners of large confined livestock operations from being eligible for cost-share assistance for animal waste storage or treatment facilities. However, technical, educational, and financial

assistance may be provided for other conservation practices on such operations. Further information relating to EQIP may be found on NRCS's website located at http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/eqipfact.html.

Conservation Reserve Program

The Conservation Reserve Program (CRP) is a highly successful conservation program administered by USDA. Since 1986, CRP has provided financial incentives to farmers and ranchers to take land out of agricultural production and plant trees, grass and other types of vegetation. The result has been reduced soil erosion, improved air and water quality, and establishment of millions of acres of wildlife habitat.

With the New Conservation Reserve Program, launched with the final rule published in the Federal Register on February 19, 1997, the Farm Service Agency (FSA) begins a renewed effort to achieve the full potential of government-farmer conservation partnerships. Only the most environmentally-sensitive land, yielding the greatest environmental benefits, will be accepted into the program.

The 36.4-million-acre congressionally mandated cap on enrollments is carried over from the previous program, meaning that the new CRP has authority to enroll only about 15 percent of the eligible cropland. To make the most of the program's potential, a new Environmental Benefits Index (EBI) was developed. The new EBI will be used to select areas and acreages offering the greatest environmental benefits.

Conservation priority areas (CPAs) are regions targeted for CRP enrollment. The four national CPAs are the Long Island Sound region, the Chesapeake Bay and surrounding areas, an area adjacent to the Great Lakes, and the Prairie Pothole region. FSA State Committees may also designate up to 10 percent of a State's remaining cropland as a State Conservation Priority Area. The NRCS is responsible for determining the relative environmental benefits of each acre offered for participation.

Continuous Sign-Up. For certain high-priority conservation practices yielding highly desirable environmental benefits, producers may sign up at any time, without waiting for an announced sign-up period. Continuous sign-up allows farmers and ranchers management flexibility in implementing certain conservation practices on their cropland. These practices are specially designed to achieve significant environmental benefits, giving participants a chance to help protect and enhance wildlife habitat, improve air quality, and improve the condition of America's waterways. Unlike the general CRP program, sign-up for these special practices is open continuously. Provided

certain eligibility requirements are met, acreage is automatically accepted into the program at a per-acre rental rate not to exceed the Commodity Credit Corporation's maximum payment amount, based on site-specific soil productivity and local prevailing cash-equivalent rental rates. For more information on the CRP, see USDA's website at http://www.fsa.usda.gov/dafp/cepd/crpinfo.htm.

Conservation Reserve Enhancement Program

The Conservation Reserve Enhancement Program (CREP), a refinement of the CRP, is a state-federal conservation partnership program targeted to address *specific* state and nationally significant water quality, soil erosion and wildlife habitat issues related to agricultural use. The program uses financial incentives to encourage farmers and ranchers to voluntarily enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production. This community-based conservation program provides a flexible design of conservation practices and financial incentives to address environmental issues. For more information about CREP, refer to USDA's website at http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm.

Wetlands Reserve Program

Congress authorized the Wetlands Reserve Program (WRP) under the Food Security Act of 1985, as amended by the 1990 and 1996 Farm Bills. USDA's Natural Resources Conservation Service (NRCS) administers the program in consultation with the Farm Service Agency and other Federal agencies. WRP is a voluntary program to restore wetlands. Landowners who choose to participate in WRP may sell a conservation easement or enter into a cost-share restoration agreement with USDA to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership.

WRP offers landowners three options: *permanent easements*, *30-year easements*, and *restoration cost-share agreements* of a minimum 10-year duration. In exchange for establishing a *permanent easement*, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetland. In exchange for the *30-year easement*, the landowner receives a payment of 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The *restoration cost-share agreement* is an agreement (generally for a minimum of 10 years) to re-establish degraded or lost wetland habitat, in which USDA pays the landowner 75 percent of the cost of the restoration activity. Restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the agreement. In all instances, landowners continue to control access to their land.

For more information about WRP, see NRCS's website at: http://wl.fb-net.org/.

Conservation Farm Option

The Conservation Farm Option (CFO) is a voluntary pilot program for producers of wheat, feed grains, cotton, and rice. The program purposes include conservation of soil, water, and related resources, water quality protection and improvement, wetland restoration, protection and creation, wildlife habitat development and protection, or other similar conservation activities. Eligibility is limited to owners and producers who have contract acreage enrolled in the Agricultural Market Transition program. Participants are required to develop and implement a conservation farm plan. The plan becomes part of the CFO contract which covers a ten year period. CFO is not restricted as to what measures may be included in the conservation plan, so long as they provide environmental benefits. During the contract period the owner or producer (1) receives annual payments for implementing the CFO contract, and (2) agrees to forgo payments under the Conservation Reserve Program, the Wetlands Reserve Program, and the Environmental Quality Incentives Program in exchange for one consolidated program.

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program (administered by NRCS) for people who want to develop and improve wildlife habitat primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

Under this program, NRCS helps participants prepare a wildlife habitat development plan in consultation with the local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement. This plan may or may not be part of a larger conservation plan that addresses other resource needs such as water quality and soil erosion.

USDA and the participant enter into a cost-share agreement that generally lasts between 5 to 10 years from the date the agreement is signed. Under the agreement: the landowner agrees to install and maintain WHIP practices and allow NRCS or its agent access to monitor the effectiveness of the practices; and USDA agrees to provide technical assistance and pay up to 75 percent of the cost of installing the wildlife habitat practices.

WHIP is currently budgeted for $50 million total through the year 2002. WHIP funds are distributed to States based on State wildlife habitat priorities, which may include wildlife habitat areas, targeted species and their habitats

and specific practices. WHIP may be implemented in cooperation with other Federal, State, or local agencies; conservation districts; or private conservation groups. For more information, see NRCS's website at http://www.nrcs.usda.gov.

Conservation of Private Grazing Land Initiative

The Conservation of Private Grazing Land initiative will ensure that technical, educational, and related assistance is provided to those who own private grazing lands. It is not a cost share program. This technical assistance will offer opportunities for better grazing and land management; protecting soil from erosive wind and water; using more energy-efficient ways to produce food and fiber; conserving water; providing habitat for wildlife; sustaining forage and grazing plants; using plants to sequester greenhouse gases and increase soil organic matter; and using grazing lands as a source of biomass energy and raw materials for industrial products.

The Wetland Conservation Provision (Swampbuster)

This provision, part of the 1985, 1990, and 1996 farm bills, requires all agriculture producers to protect wetlands on the farms they own or operate if they want to be eligible for USDA farm program benefits. The Swampbuster program generally allows the continuation of most ongoing farming practices as long as wetlands are not converted or wetland drainage increased. The program discourages farmers from altering wetlands by withholding Federal farm program benefits from any person who does the following:

- Plants an agricultural commodity on a converted wetland that was converted by drainage, dredging, leveling or any other means after December 23, 1985.
- Converts a wetland for the purpose of or to make agricultural commodity production after November 28, 1990.

In order to ensure farm program benefits under the Swampbuster provisions, the local NRCS office should be contacted before clearing, draining, or manipulating any wet areas on any farmland.

VII.D. Other Voluntary Initiatives

NICE^3

The U.S. Department of Energy sponsors a grant program called National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). The NICE^3 program provides funding to state and industry partnerships (large and small businesses) for projects demonstrating advances in energy efficiency and clean production technologies. The goal of the NICE^3 program is to demonstrate the performance and economics of innovative

technologies in the U.S., leading to the commercialization of improved industrial manufacturing processes. These processes should conserve energy, reduce waste, and improve industrial cost-competitiveness. Industry applicants must submit project proposals through a state energy, pollution prevention, or business development office. Awardees receive a one-time, three-year grant of up to $400,000, representing up to 50 percent of a project's total cost. In addition, up to $25,000 is available to support the state applicant's cost share. (Contact: View the website at http//www.oit.doe.gov/Access/nice3; Steve Blazek, DOE, (303) 275-4723; or Eric Hass, DOE, (303) 275-4728.)

ISO 14000

ISO 14000 is a series of internationally-accepted standards for environmental management. The series includes standards for environmental management systems (EMS), guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of over 110 country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO. Information on ISO is available at the following Internet site: http://www.iso.ch/welcome.html.

American Forest and Paper Association Sustainable Forest Initiative (SFI)

The Sustainable Forestry Initiative (SFI) program is a comprehensive system of principles, objectives and performance measures that integrates the perpetual growing and harvesting of trees with the protection of wildlife, plants, soil and water quality. AFPA members are committed to following the substance and spirit of best management practices (BMPs) on their own land and in operations they are involved in with other landowners and loggers.

VII.E. Summary of Trade Associations

There are more than 200 trade associations that deal with agricultural issues. Many of these are at the national level, while others deal specifically with regions of the country or individual states. The following identify some of the major associations addressing agricultural production.

Agricultural Retailers Association (ARA)
11701 Borman Drive, Suite 110
St. Louis, MO 63146
314-567-6655

American Farm Bureau Federation
Headquarters Office
225 Touhy Ave.
Park Ridge, IL 60068
847-685-8600

Washington, DC Office
600 Maryland Ave., S.W.
Washington, DC 20024
202-484-3600

American Feed Industry Association
1501 Wilson Blvd., Suite 1100
Arlington, VA 22209
703-524-0810

American Oat Association
415 Shelard Parkway, Suite 101
Minneapolis, MN 55426
612-542-9817

American Society of Agronomy
677 S. Segoe Rd.
Madison, WI 53711
608-273-8080 ext.3030

American Sugarbeet Growers Association
156 15th Street, NW, Suite 1101
Washington, DC 20005
202-833-2398

American Crop Protection Association
1156 15th Street, NW, Suite 400
Washington, DC 20005
202-296-1595

American Forest & Paper Association (AF&PA)
1111 19th St., NW, Suite 800
Washington, DC 20036
202-463-2700
E-mail: INFO@afandpa.org

American Nursery & Landscape Association
1250 I Street, NW
Suite 500
Washington, DC 20005
202-789-2933

American Pulpwood Association, Inc.
600 Jefferson Plaza, Suite 350
Rockville, Maryland 20852
301-838-9385

American Soybean Association
540 Maryville Centre Drive
PO Box 419200
St. Louis, MO 63141
314-576-1770

Association of American Pesticide Control Officials
P.O. Box 1249
Hardwick, VT 05843
802-472-6956

Association of American Plant Food Control Officials (AAPFCO)
Food & Drug Protection Division
North Carolina Department of Agriculture
4000 Reedy Creek Rd.
Raleigh, NC 27607
919-733-7366

Burley Tobacco Growers Cooperative Association
PO Box 860
Lexington, KY 40587
606-252-3561

Clean Water Network
1200 New York Ave, NW
Washington, DC 20005
202-287-2395

California Fertilizers Association
1700 I St., Suite 130
Sacramento, CA 95814
916-441-1584

Eastern Dark-fired Tobacco Growers Association
1109 S. Main Street
PO Box 517
Springfield, TN 37172
615-384-4543

Conservation Technology Information Center (CTIC)
1220 Potter Drive, Room 170
West Lafayette, IN 47906-1383
765-494-9555

Environmental Working Group
1101 Wilson Blvd
Arlington, VA 22209
703-243-3002

Farmworker Justice Fund
1111 19th Street, NW Suite 1000
Washington, DC 20036
202-776-1757

Forest Landowners Association
P.O. Box 95385
Atlanta, Georgia 30347
800-325-2954

Garden Centers of America
1250 I Street, NW, Suite 500
Washington, DC 20005
202-789-2900

Institute for Agriculture and Trade Policy
2105 1st Avenue South
Minneapolis, MN 55404
612-870-0453

National Association of State Departments of Agriculture (NASDA)
1156 15th St., NW, Suite 1020
Washington, DC 20005
202-296-9680

National Association of Wheat Growers
415 2nd Street, NE, Suite 300
Washington, DC 20002
202-547-7800

National Coalition Against the Misuse of Pesticides
701 E Street, SE #200
Washington, DC 20003
202-543-5450

National Corn Growers Association
1000 Executive Parkway, Suite 105
St. Louis, MO 63141
314-275-9915

National Cotton Council
1521 New Hampshire Avenue, NW
Washington, DC 20036
202-745-7805

National Council of Farmer Coops. (NCFC)
50 F Street, NW, Suite 900
Washington, DC 20001

National Hay Association
102 Treasure Island Causeway
Suite 201
St. Petersburg, FL 33706
813-367-9702

National Sunflower Association
4023 State Street
Bismark, ND 58501
701-328-5100

Society of American Foresters
5400 Grosvenor Lane
Bethesda, MD 20814
301-897-8720
E-mail: safweb@safnet.org

United Farm Workers of America
1188 Franklin Street, Suite 203
San Francisco, CA 94109
415-674-1884

USDA's Forest Service
Auditors Building
201 14th Street, S.W.
Washington, DC 20024
202-205-1661

National Council of Agricultural Employers
1112 6th Street, NW, Suite 920
Washington, DC 20036
202-728-0300

National Grain and Feed Association
1201 New York Avenue, NW
Suite 830
Washington, DC 20005
202-289-0873

National Pest Control Association
8100 Oak Street (NPCA)
Dunn Loring, VA 22027
703-573-8330

Potato Association of America
University of Idaho
1776 Science Center Drive
Idaho Falls, ID 83402
208-529-8376

The Fertilizer Institute (TFI)
501 Second Street, NE
Washington, DC 20002

USA Rice Council
PO Box 740123
Houston, TX 77274
713-270-6699

VIII. CONTACTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the agricultural crop production industries, a list of contacts and publications are provided below.

Contacts[2]

Name	Organization	Telephone	Subject
Ginah Mortensen	EPA, Office of Enforcement and Compliance Assurance (OECA), Agriculture Division, Agriculture Branch	913-551-5211	Notebook Contact
Arty Williams	EPA, Office of Prevention, Pesticides and Toxic Substances (OPPT)	703-305-5239	Ground Water Pesticide Management Plan Rule
Jean Frane	EPA, OPPT	703-305-5944	Food Quality Protection Act
David Stangel	EPA, OECA	202-564-4162	Stored or Suspended Pesticides; Good Laboratory Practice Standards; Pesticide Management and Disposal
Joseph Hogue	EPA, OPPT	703-308-9072	FIFRA Restricted Use Classifications
Robert McNally	EPA, OPPT	703-308-8085	FIFRA Pesticide Tolerances
Joseph Nevola	EPA, OPPT	703-308-8037	FIFRA Pesticide Tolerances
Ellen Kramer	EPA, OPPT	703-305-6475	FIFRA Pesticide Tolerances
Robert A. Forrest	EPA, OPPT	703-308-9376	FIFRA Exemptions
Nancy Fitz	EPA, OPPT	703-305-7385	FIFRA Pesticide Management and Disposal
John MacDonald	EPA, OPPT	703-305-7370	Certification and Training

[2] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Kevin Keaney	EPA, OPPT	703-305-5557	FIFRA Worker Protection Standards
Al Havinga	EPA, OECA	202-564-4147	Livestock Issues
Carol Galloway	EPA, OECA	913-551-5008	Livestock Issues
Sharon Buck	EPA, OWOW	202-260-0306	NonPoint Source Issues
Greg Beatty	EPA, OWM	202-260-6929	NPDES Permniting Issues
Roberta Parry	EPA, OPEI	202-260-2876	Livestock and Crop Issues
Robin Dunkins	EPA, OAQPS	919-541-5335	Air Issues
Kurt Roos	EPA, OAR	202-564-9041	Atmospheric Programs
Howard Beard	EPA, OGWDW	202-260-8796	Drinking water Issues
Tracy Back	EPA, CCSMD	202-564-7076	Compliance Assistance Centers

General Profile

1997 National Resources Inventory - Summary Report, National Resources Conservation Service, United States Department of Agriculture. December 1999.

Occupational Outlook Handbook Home Page, Bureau of Labor Statistics Home Page. December 1996.

SIC Code Profile 01 and 07, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Draft, September 30, 1994.

Newsletter: *Small and Part Time Farms*, U.S. Department of Agriculture, Fall 1996.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Enforcement and Compliance Assurance Accomplishments Report, FY 1994, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R94-003), April 1995.

Enforcement and Compliance Assurance Accomplishments Report, FY 1995, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R94-003), April 1996.

Enforcement and Compliance Assurance Accomplishments Report, FY 1996, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R-97-003), 1997.

Enforcement and Compliance Assurance Accomplishments Report, FY 1997, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R-98-003), July 1998.

Occupational Outlook Handbook Home Page, Bureau of Labor Statistics Home Page. December 1996.

North American Industrial Classification System, Office of Management and Budget.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Agriculture Census, 1992 and 1997.

Operations and Pollution Prevention

Best Management Practices for Field Production of Nursery Stock, North Carolina State University Biological and Agricultural Engineering Extension Service (http://www.bae.ncsu.edu/programs/extension/ag-env/nursery/).

Biocontrol of Plant Diseases Laboratory, Agricultural Research Service, 1997 Internet search.

1998 Crop Residual Management Survey Executive Summary, Top 10 Conservation Tillage Benefits, Conservation Tillage Information Center.

Effect of pH on Pesticide Stability and Efficacy, Winand K. Hock, Penn State University (http://pmep.cce.cornell.edu/facts-slides-self/facts/gen-peapp-ph.html).

Environmental Guidelines for Greenhouse Growers - Site Planning, British Columbia Ministry (http://www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/greenhse/grnhse.htm).

Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, U.S. Environmental Protection Agency (http://www.epa.gov/OWOW/NPS/MMGI/) January 1993.

Nonpoint Source Pollution: The Nation's Largest Water Quality Problem Pointer No. 1, US EPA 1996.

NRCS Conservation Practice Standards, http://www.ncg.usda.gov/practice_stds.html.

Principles of Irrigation Management: Water Management Guidelines for Nursery/Floral Producers, 1997, http://aggie-horticulture.tamu.edu/greenhouse/environ/wmprinc.html).

Texas Greenhouse Management Handbook, Dr. Don Wilkerson, Texas Agricultural Extension Service (http://aggie-horticulture.tamu.edu/greenhouse/guides/green/green.html) (no date).

Treating and Recycling Irrigation Runoff: Water Management Guidelines for Nursery/Floral Producers, 1997, http://aggie-horticulture.tamu.edu/greenhouse/environ/wmrecyc.html).

Water Quality and Waste Management, North Carolina Cooperative Extension, http://www2.ncsu.edu/bae/programs/extension/publicat/wqwm/index.html.

Miller, W.P., "Environmental Considerations in Land Application of By-Product Gypsum," *Agricultural Utilization of Urban and Industrial By-Products*, American Society of Agronomy, Madison, WI, 1995.

Regulatory Profile

Ag Environmental Programs, http://es.epa.gov/oeca/ag/aglaws/.

Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution, Environmental Law Institute, 1997.

1996 Farm Bill Conservation Provisions, http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/FBillLnk.html.

1996 Farm Bill Summary, http://www.usda.gov/farmbill/title0.htm.

Major Existing EPA Laws and Programs That Could Affect Producers of Agricultural Commodities, U.S. Environmental Protection Agency, Agriculture and Ecosystems Division, August 8, 1996.

Overview of the Storm Water Program, Office of Water, U.S. Environmental Protection Agency, June 1996. EPA 833-R-96-008.

U.S. EPA Permit Writers' Manual, U.S. Environmental Protection Agency, Office of Water (EPA-833-B-96-003) December 1996.

Haugrud, K. Jack. "Agriculture," Chapter 8 in *Sustainable Environmental Law, Integrating Natural Resource and Pollution Abatement Law from Resources to Recovery*, Environmental Law Institute, St. Paul, 1993.

Landfair, Stanley W. "Toxic Substances Control Act," Chapter 11 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Miller, Marshall E. "Federal Regulation of Pesticides," Chapter 13 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Other Resources

AgNIC, http://www.agnic.org/.

*Farm*A*Syst*, http://www.wisc.edu/farmasyst/index.html.

The Quality of Our Nation's Water, http://www.epa.gov/305b.

Manure Master Decision Support Tool, http://www.ftw.nrcs.usda.gov/ManureMaster/.

State Partners of the Cooperative State Research, Education, and Extension Service, http://www.reeusda.gov/statepartners/usa.htm.

Charge your order,
It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800
Order online at http://bookstore.gpo.gov

Order Processing Code: 3212

Qty	GPO Stock #	Title	Price (each)	Total
		Published in 1995		
	005-000-00512-5	Profile of the Dry Cleaning Industry, 104 pages	$6.50	
	055-000-00513-3	Profile of the Electronics and Computer Industry, 160 pages	$11.00	
	055-000-00518-4	Profile of the Fabricated Metal Products Industry, 164 pages	$11.00	
	055-000-00515-0	Profile of the Inorganic Chemical Industry, 136 pages	$9.00	
	005-000-00516-8	Profile of the Iron and Steel Industry, 128 pages	$8.00	
	055-000-00517-6	Profile of the Lumber and Wood Products Industry, 136 pages	$9.00	
	055-000-00519-2	Profile of the Metal Mining Industry, 148 pages	$10.00	
	055-000-00520-6	Profile of the Motor Vehicle Assembly Industry, 156 pages	$11.00	
	055-000-00521-4	Profile of the Nonferrous Metals Industry, 140 pages	$9.00	
	055-000-00522-2	Profile of the Non-Fuel, Non-Metal Mining Industry, 108 pages	$6.00	
	055-000-00523-1	Profile of the Organic Chemical Industry, 152 pages	$11.00	
	055-000-00524-9	Profile of the Petroleum Refining Industry, 124 pages	$11.00	
	005-000-00525-7	Profile of the Printing Industry, 124 pages	$7.50	
	055-000-00526-5	Profile of the Pulp and Paper Industry, 156 pages	$11.00	
	055-000-00527-3	Profile of the Rubber and Plastic Industry, 152 pages	$11.00	
	055-000-00528-1	Profile of the Stone, Clay, Glass and Concrete Industry, 124 pages	$7.50	
	055-000-00529-0	Profile of the Transportation Equipment Cleaning Industry, 84 pages	$5.50	
	055-000-00514-1	Profile of the Wood Furniture and Fixtures Industry, 132 pages	$8.00	
		Published in 1997		
	055-000-00570-2	Profile of the Air Transportation Industry, 90 pages	$7.50	
	055-000-00576-1	Profile of the Fossil Fuel Electric Power Generation Ind., 160 pages	$14.00	
	055-000-00571-1	Profile of the Ground Transportation Industry, 130 pages	$10.00	
	055-000-00573-7	Profile of the Metal Casting Industry, 150 pages	$13.00	
	055-000-00574-5	Profile of the Pharmaceutical Manufacturing Industry, 147 pages	$13.00	
	055-000-00575-3	Profile of the Plastic Resin & Man-made Fiber Industry, 180 pages	$15.00	
	055-000-00577-0	Profile of the Shipbuilding and Repair Industry, 120 pages	$9.50	
	055-000-00578-8	Profile of the Textile Industry, 130 pages	$10.00	
	055-000-00572-9	Profile of the Water Transportation Industry, 90 pages	$7.50	
		Published in 1998		
	055-000-00579-6	Sector Notebook Data Refresh-1997, 210 pages	$17.00	
	055-000-00619-9	Profile of the Aerospace Industry, 130 pages	$10.00	
		Published in 1999		
	055-000-00620-2	Profile of Local Government Operations, 310 pages	$25.00	
		Published in 2000		
	055-000-00635-1	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry, 200 pp.	$18.00	
	055-000-00636-9	Profile of the Agricultural Crop Production Industry, 178 pages	$16.00	
	055-000-00633-4	Profile of the Agricultural Livestock Production Industry, 159 pages	$15.00	
	055-000-00634-2	Profile of the Oil and Gas Extraction Industry,	$16.00	

The total cost of my order is $_____. Price includes regular shipping and handling and is subject to change. International orders add 25 percent.

_____
Company or personal name (please type or print)

_____
Additional address/attention line

_____
Street Address

_____
City, State, Zip Code

_____
Daytime phone including area code

Check method of payment:
☐ Check payable to Superintendent of Documents
☐ GPO Deposit Account_____
☐ VISA ☐ MasterCard ☐ Discover/NOVUS
Credit Card # _____
Expiration date _____ *Thank you for your order!*

_____
Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954

****Important: Please include completed order form with payment**