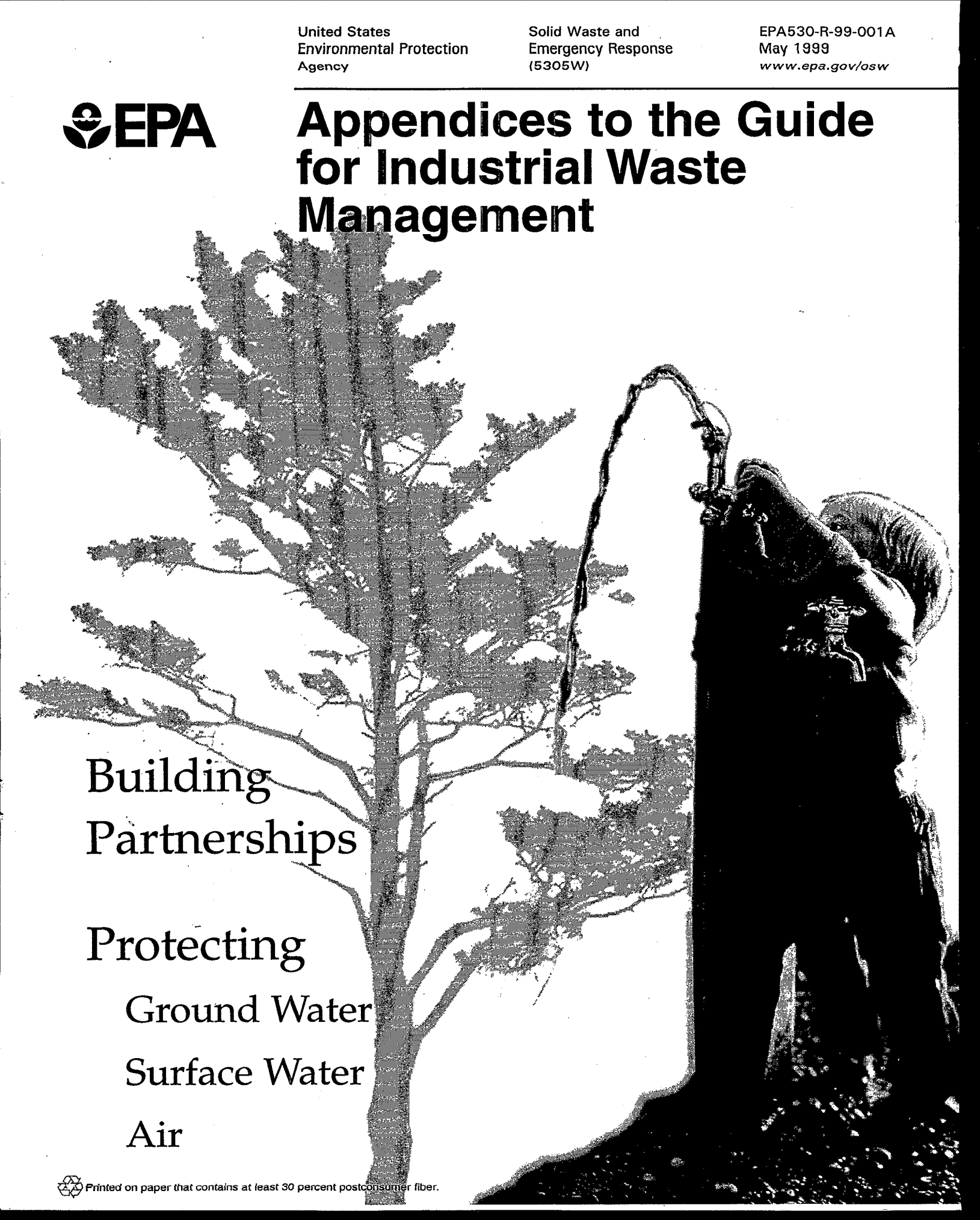




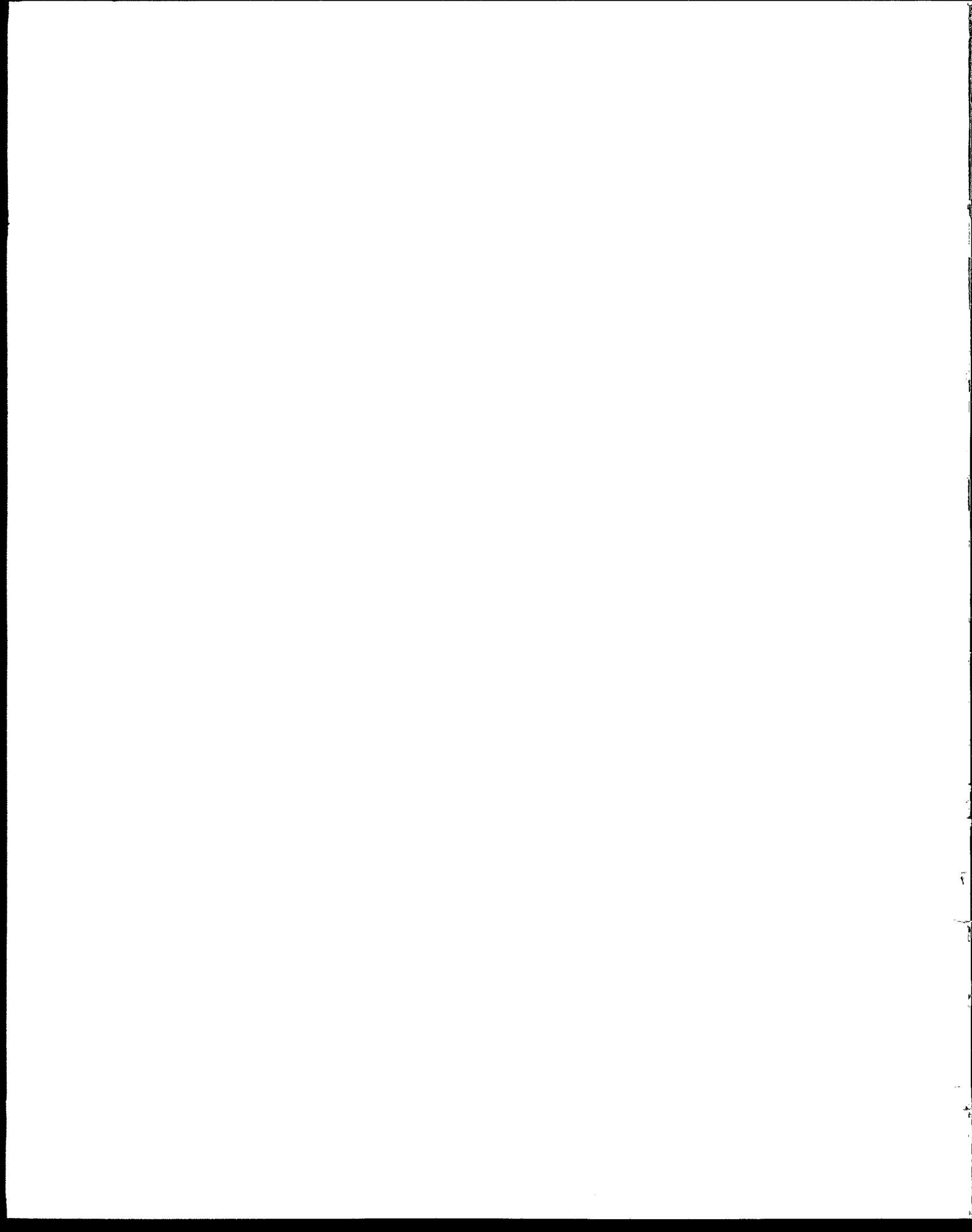
Appendices to the Guide for Industrial Waste Management

A black and white photograph of a large, leafy tree on the left and a person in a dark, hooded garment on the right. The person is holding a long, thin, curved object, possibly a pipe or a branch, which extends from the top right towards the center of the image. The background is a light, textured surface.

Building
Partnerships

Protecting
Ground Water
Surface Water
Air



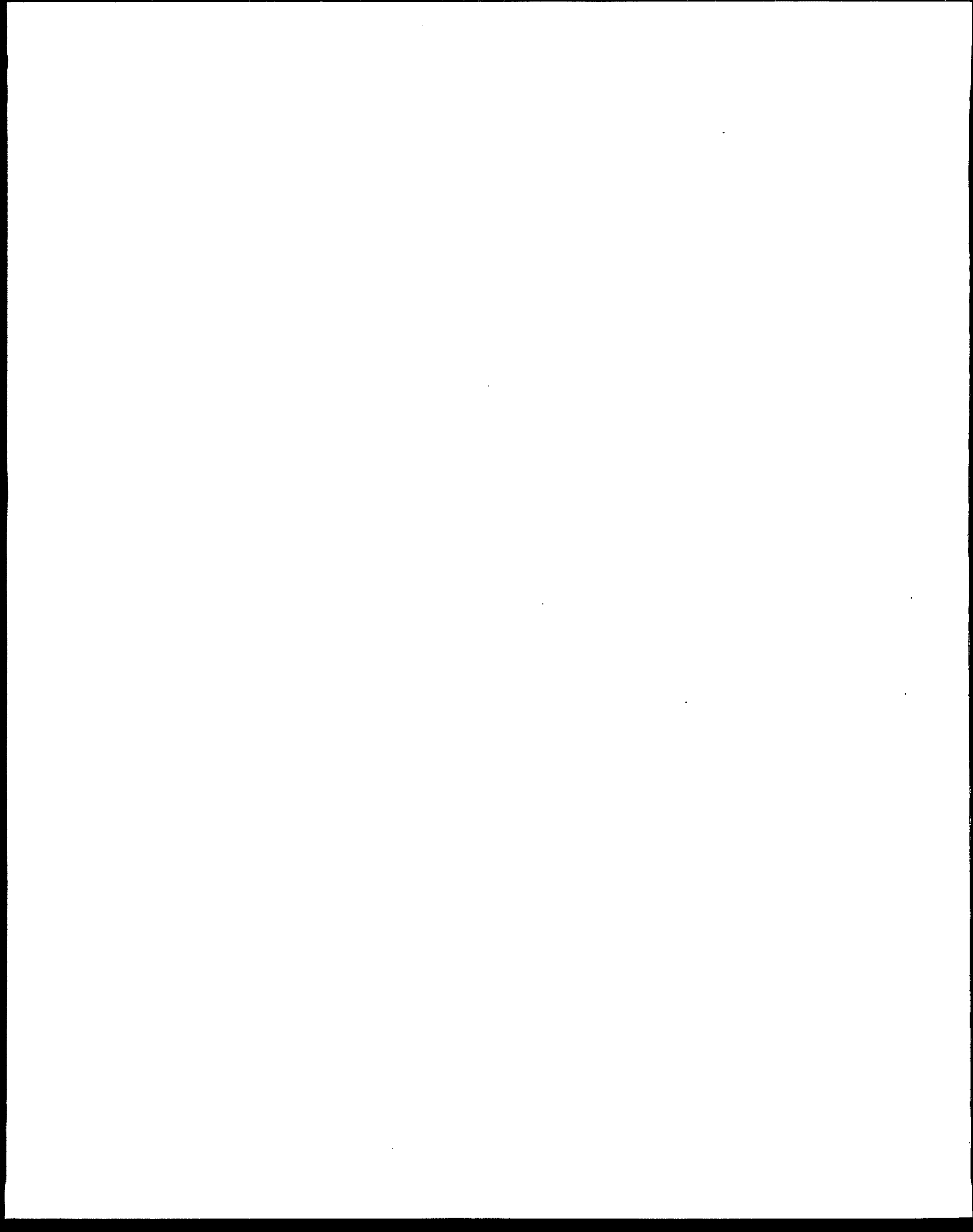


Proposed Guide For Industrial Waste Management For Public Comment Appendices

EPA530-R-99-001A

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
401 M Street, SW
Washington, DC 20460

1999



BUILDING PARTNERSHIPS
APPENDICES

Appendix I: State Solid Waste Contacts

ALABAMA

Department of Environmental Management (ADEM)

Land Division
P.O. Box 301463
Montgomery, AL 36130-1463

Phone: 334 271-7730
Fax: 334 279-3050
Web site: www.adem.state.al.us

Alaska Department of Environmental Conservation Solid Waste Management

ADEC Division of Environmental Health
410 Willoughby Avenue, Suite 105
Juneau, AK 99801-1795

Phone: 907 465-5162
Fax: 907 465-5164
Web site: [www.state.ak.us/local/akpages/
env.conserv/dec_div.htm](http://www.state.ak.us/local/akpages/env.conserv/dec_div.htm)

Arizona Department of Environmental Quality Waste Programs Division

3033 North Central Avenue, # 3048
Phoenix, AZ 85012

Phone: 602 207-4865
Fax: 602 207-2383
Web site: www.adeq.state.az.us/index.htm

Arkansas Department of Pollution Control and Ecology Solid Waste Management Division

P.O. Box 8913
Little Rock, AR 72219

Phone: 501 682-0600
Fax: 501 682-0565
Web site: [www.adeq.state.ar.us/solwaste/
main.htm](http://www.adeq.state.ar.us/solwaste/main.htm)

California Integrated Waste Management Board

8800 Cal Center Drive
Sacramento, CA 95826

Phone: 916 255-2200 or 800 553-2962
Fax: 916 255-2220
Web site: www.ciwmb.ca.gov

California Department of Conservation Recycling Market Development

801 K Street, MS 18-55
Sacramento, CA 95814

Phone: 916 327-2760
Fax: 916 324-1224
Web site: www.consrv.ca.gov

Colorado Department of Public Health and Environment

HMWMD-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1530

Phone: 303 692-3300
Fax: 303 759-5355
Web site: [www.state.co.us/gov_dir/
cdphe_dir/hm/hmhom.html](http://www.state.co.us/gov_dir/cdphe_dir/hm/hmhom.html)

Connecticut Department of Environmental Protection

Waste Management Bureau Office of Recycling and Source Reduction

79 Elm Street
Hartford, CT 06106-5127

Phone: 860 424-3021
Fax: 860 424-4060
Web site: dep.state.ct.us

Appendix I: State Solid Waste Contacts (cont.)

Delaware Department of Natural Resources and Environmental Control Division of Air and Waste Management

89 Kings Highway
P.O. Box 1401
Dover, DE 19903

Phone: 302 739-6400
Fax: 302 739-5060
Web site: www.dnrec.state.de.us

Florida Department of Environmental Protection Division of Waste Management

2600 Blair Stone Road
Tallahassee, FL 32399-2400

Phone: 850 488-0300
Fax: 850 921-8061
Web site: www2.dep.state.fl.us/waste/programs.htm

Georgia Department of Natural Resources

7 Martin Luther King Jr. Drive, Suite 450
Atlanta, GA 30334

Phone: 404 651-5120
Fax: 404 651-5130
Web site: www.dnr.state.ga.us/dnr

Hawaii Department of Health Office of Solid Waste Management

919 Ala Moana Boulevard
Honolulu, HI 96814

Phone: 808 586-4240
Fax: 808 586-7509
Web site: www.hawaii.gov/health/ei/emsweiems00.htm

Idaho Division of Environmental Quality

1410 North Hilton
Boise, ID 83706

Phone: 208 373-0502
Fax: 208 373-0169
Web site: www2.state.id.us/deq

Illinois Environmental Protection Agency

1021 North Grand Avenue East
Springfield, IL 62702

Phone: 217 782-3397
Web site: www.epa.state.il.us

Illinois Recycling Association

P.O. Box 3717
Oak Park, IL 60303-3717

Phone: 708 358-0050
Fax: 708 358-0051

Indiana Department of Environmental Management Office of Solid & Hazardous Waste Management

P.O. Box 6015
Indianapolis, IN 46206-6015

Phone: 317 233-3656 or 800 451-6027
(in Indiana)
Fax: 317 232-3403
Web site: www.ai.org/idem/oshwm/index.html

Iowa Department of Natural Resources Environmental Protection Division

Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319-0034

Phone: 515 281-6284
Web site: www.state.ia.us/government/dnr/organiza/epd/index.htm

Appendix I: State Solid Waste Contacts (cont.)

Kansas Department of Health and Environment

Forbes Field, Building 740
Topeka, KS 66620
Phone: 785 296-1600
Fax: 785 296-1592
Web site: www.state.ks.us/kdhe/waste

Kentucky Department for Environmental Protection

Division of Waste Management
14 Reilly Road
Frankfort, KY 40601
Phone: 502 564-6716
Fax: 502 564-4049
Web site: www.state.ky.us/agencies/nrepc/waste/dwmhome.htm

Louisiana Department of Environmental Quality Office of Waste Services

P.O. Box 82178
Baton Rouge, LA. 70884-2178
Phone: 225 765-0355
Fax: 225 765-0617
Web site: www.deq.state.la.us/welcome.htm

Maine Department of Environmental Protection

17 State House Station
Augusta, ME 04333-0017
Phone: 207 287-7688 or 800 452-1942
Web site: www.state.me.us/dep/mdephhome.htm

Maryland Department of the Environment

2500 Broening Highway
Baltimore, MD 21224
Phone: 410 631-3315 or 800 633-6100
Fax: 410 631-3842
Web site: www.mde.state.md.us

Massachusetts Department of Environmental Protection Division of Solid Waste Management

1 Winter Street, Fourth Floor
Boston, MA 02108
Phone: 617 338-2255 or 800 462-0444
(in Massachusetts)
Web site: www.state.ma.us/dep

Michigan Department of Environmental Quality

Waste Management Division
John Hannah Building, First Floor
608 West Allegan Street
P.O. Box 30241
Lansing, MI 48933
Phone: 517 373-2730
Fax: 517 373-4797
Web site: www.deq.state.mi.us/wmd

Minnesota Office of Environmental Assistance

520 Lafayette Road North, Second Floor
St. Paul, MN 55155-4100
Phone: 651 296-3417 or 800 657-3843
Fax: 651 215-0246
Web site: www.moea.state.mn.us

Minnesota Pollution Control Agency

520 Lafayette Road North
St. Paul, MN 55155-4194
Phone: 612 296-6300 or 800 657-3864
Fax: 612 296-8717
Web site: www.pca.state.mn.us

Appendix I: State Solid Waste Contacts (cont.)

Mississippi Department of Environmental Quality

P.O. Box 20305
Jackson, MS 39289-1305
Phone: 601 961-5171
Fax: 601 961-5349
Web site: [www.deq.state.ms.us/
domino/deqweb.nsf](http://www.deq.state.ms.us/domino/deqweb.nsf)

Missouri Department of Natural Resources Division of Environmental Quality Solid Waste Management Program

P. O. Box 176
Jefferson City, MO 65102
Phone: 573 751-5401
Web site: [www.dnr.state.mo.us/deq/
swmp/homeswmp.htm](http://www.dnr.state.mo.us/deq/swmp/homeswmp.htm)

Montana Department of Environmental Quality Solid Waste Program

P.O. Box 200901
Helena, MT 59620-0901
Phone: 406 444-5307
Fax: 406 444-6836
Web site: www.deq.mt.gov

Nebraska Department of Environmental Quality

1200 N Street, Suite 400
P.O. Box 98922
Lincoln, NE 68509-8922
Phone: 402 471-2186
Fax: 402 471-2909
Web site: www.deq.state.ne.us

Nevada Division of Environmental Protection

Solid Waste Branch
333 West Nye Lane
Carson City, NV 89706-0851
Phone: 702 687-4670
Fax: 702 687-6396

New Hampshire Department of Environmental Services

6 Hazen Drive
Concord, NH 03302-0095
Phone: 603 271-2900
Fax: 603 271-2456
Web site: www.state.nh.us/des

New Jersey Department of Environmental Protection Division of Solid Waste Management

401 East State Street, 7th Floor,
East Wing
P.O. Box 402
Trenton, NJ 08625-0402
Phone: 609 292-2885
Fax: 609 292-7695
Web site: www.state.nj.us/dep

New Mexico Environmental Department

Harold S. Runnels Building
1190 St. Francis Drive
Santa Fe, NM 87505-4182
Phone: 505 827-2855 or 800 879-3421
Web site: www.nmenv.state.nm.us

Appendix I: Technical Assistance Organizations (cont.)

**New York Department of Environmental
Conservation
Division of Solid and Hazardous Materials**

50 Wolf Road
Albany, NY 12233-7253
Phone: 518 457-6934
Fax: 518 457-1283
Web site: [www.dec.state.ny.us/website/
pollution/index.html](http://www.dec.state.ny.us/website/pollution/index.html)

**North Carolina Department of
Environmental Health and Natural
Resources**

Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605
Phone: 919 733-0692
Web site: [wastenot.ehnr.state.nc.us/
swhome/swhome.htm](http://wastenot.ehnr.state.nc.us/swhome/swhome.htm)

**North Dakota Department of Health
Division of Waste Management
Solid Waste Program**

P.O. Box 5520
1200 Missouri Avenue, Room 302
Bismarck, ND 58506-5520
Phone: 701 328-5153
Fax: 701 28-5200
Web site: [www.ehs.health.state.nd.us/
ndhd/environ/wm/swp/index.htm](http://www.ehs.health.state.nd.us/ndhd/environ/wm/swp/index.htm)

**State of Ohio Environmental Protection
Agency
Division of Solid and Infectious Waste
Management's (DSIWM)**

1800 Watermark Drive
P.O. Box 1049
Columbus, OH 43216-1049
Phone: 614 644-2621
Fax: 614 728-5315
Web site: [www.epa.state.oh.us/dsiwm/
dsiwmain.html](http://www.epa.state.oh.us/dsiwm/dsiwmain.html)

**Ohio Department of Natural Resources
Division of Recycling & Litter Prevention**

Fountain Square, Building F-2
Columbus, OH 43224
Phone: 614 265-6333
Fax: 614 262-9387
Web site: [www.dnr.state.oh.us/odnr/
recycling](http://www.dnr.state.oh.us/odnr/recycling)

**Oklahoma Department of Environmental
Quality
Waste Management, Recycling, and Waste
Reduction**

707 North Robinson
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: 405 271-5338
Fax: 405 271-8425
Web site: www.deq.state.ok.us

**Oregon Department of Environmental
Quality
Solid Waste Policy and Program
Development Section**

811 SW Sixth Avenue
Portland, OR 97204
Phone: 503 229-5913 or 880 452-4011
Fax: 503 229-6954
Web site: [www.deq.state.or.us/wmc/
solwaste/rsww.htm](http://www.deq.state.or.us/wmc/solwaste/rsww.htm)

**Pennsylvania Department of Environmental
Resources**

P.O. Box 8472
Harrisburg, PA 17105-8472
Phone: 717 787-7382
Fax: 717 787-1904
Web site: www.dep.state.pa.us

Appendix I: Technical Assistance Organizations (cont.)

Rhode Island Department of Environmental Management

235 Promenade Street
Providence, RI 02908
Phone: 401 277-3434
Fax: 401 277-2591
Web site: www.state.ri.us/dem

South Carolina Department of Health and Environmental Control

Environmental Quality Control
2600 Bull Street
Columbia, SC 29201
Phone: 803 734-5360
Fax: 803 734-4901
Web Site: www.state.sc.us/dhec/eqchome.htm

South Dakota Department of Environment and Natural Resources

523 East Capitol Avenue
Pierre, SD 57501
Phone: 605 773-3153
Fax: 605 773-6035
Web site: www.state.sd.us/denr/denr.html

Tennessee Department of Environment and Conservation

Division of Solid Waste Assistance

L & C Tower, 14th Floor
401 Church Street
Nashville, TN 37243-0455
Phone: 615 532-0070
Web site: www.state.tn.us/environment/swa

Texas Natural Resource Conservation Commission

Office of Waste Management
P.O. Box 13087
Austin, TX 78711-3087
Phone: 512 239-5200
Fax: 512 239-5151
Web site: www.tnrcc.texas.gov/waste

Utah Department of Environmental Quality

P.O. Box 144810-4810
168 North 1950 West
Salt Lake City, Utah 84114-4810
Phone: 801 536-4400 or 800 458-0145
Fax: 801 536-4401
Web site: www.eq.state.ut.us

Vermont Agency of Natural Resources Environmental Assistance

103 South Main Street
Waterbury, VT 05671-0411
Phone: 802 241-3477
Fax: 802 241-3273
Web site: www.anr.state.vt.us/waste.htm

Virginia Department of Environmental Quality

629 East Main Street
P.O. Box 10009
Richmond, VA 23240-0009
Phone: 804 698-4000 or 800 592-5482
(in Virginia)
Fax: 804 698-4453
Web site: www.deq.state.va.us/deq/homepage.html

Appendix I: Technical Assistance Organizations (cont.)

**Washington Department of Ecology
Solid Waste Services Program**

P.O. Box 47600
Olympia, WA 98504-7600

Phone: 360 407-7455

Fax: 360 407-6102

Web site: www.wa.gov/ecology

**West Virginia Bureau of Environment
Solid Waste Management Board**

1615 Washington Street, East
Charleston, WV 25311-2126

Phone: 304 558-0844

Fax: 304 558-0899

Web site: www.state.wv.us/swmb

**Wisconsin Department of Natural
Resources
Bureau of Solid and Hazardous Waste
Management**

P.O. Box 7921
Madison, WI 53707-7921

Phone: 608 266-2111

Fax: 608 267-2768

Web site: www.dnr.state.wi.us

**Wyoming Department of Environmental
Quality
Solid and Hazardous Waste Division**

250 Lincoln Street
Lander, WY 82520

Phone: 307 332-6924

Fax: 307 332-7726

Web site: deq.state.wy.us

Appendix II: Examples of Public Involvement Activities

1. CMA's Responsible Care®

To address citizens' concerns about the manufacture, transport, use, and disposal of chemical products, the Chemical Manufacturers Association (CMA) launched its Responsible Care® program in 1988. One of the guiding principles of the program is recognizing and responding to community concerns about chemicals and facility operations. CMA is committed to fostering an open dialogue with residents of the communities in which member companies are located.

To maintain their membership in CMA companies must participate in the Responsible Care® program. In addition, the program establishes a public advisory panel that helps CMA identify community concerns and suggests ways to resolve those concerns. The panel currently comprises 15 members, including representatives from both public and private sectors. The number of industry members is kept to a minimum to ensure that a balance of voices will be heard.

Member companies are required to address community concerns in two ways: (1) by developing and maintaining community outreach programs, and (2) by assuring that each facility has an emergency response program in place. For example, member companies must provide information about their waste minimization and emissions reduction activities, as well as provide convenient ways for citizens to become familiar with the facility, such as tours. Companies must also develop written emergency response plans that include information about how to communicate with members of the public and consider their needs after an emergency.

Responsible Care® is just one example of how public involvement principles can be incorporated into everyday business prac-

tices. The program also shows how involving the public makes good business sense. For more information about Responsible Care®, contact CMA at 703 741-5000.

2. AF&PA's Sustainable Forestry Initiative

Public concern about the future of America's forests coupled with the American Forest & Paper Association's (AF&PA's) belief that "sound environmental policy and sound business practice go hand in hand" fueled the establishment of the Sustainable Forestry Initiative (SFI). Established in 1995, the SFI outlines principles and objectives for environmental stewardship that all AF&PA members must comply with in order to retain membership. SFI encourages protecting wildlife habitat and water quality, reforestation harvested land, and conserving ecologically sensitive forest land. SFI recognizes that continuous public involvement is crucial to its ultimate goal of "ensuring that future generations of Americans will have the same abundant forests that we enjoy today."

The SFI stresses the importance of reaching out to the public through toll-free information lines, environmental education, private and public sector technical assistance programs, workshops, videos, and other means. To help keep the public informed of achievements in sustainable forestry, members report annually on their progress, and AF&PA distributes the resulting publication to interested parties. In addition, AF&PA runs two national forums a year, which bring together loggers, landowners, and senior industry representatives to review progress toward SFI objectives.

Many AF&PA state chapters have developed additional activities to inform the public about the SFI. For example, in New Hampshire, AF&PA published a brochure about sustainable forestry and used it to brief local sawmill officials and the media.

Appendix II: Examples of Public Involvement Activities (cont.)

In Vermont, a 2-hour interactive television session allowed representatives from industry, public agencies, environmental organizations, the academic community, and private citizens to share their views on sustainable forestry. Furthermore, in West Virginia, AF&PA formed a Woodland Owner Education Committee to reach out to nonindustrial private landowners.

For more information about the SFI, contact AF&PA at 1 800 878-8878, or visit the web site www.afandpa.org.

CHARACTERIZING WASTE
APPENDICES

Example Extraction Tests (Draft 9/30/97)

TEST METHOD	LEACHING FLUID	LIQUID:SOLID RATIO	MAXIMUM PARTICLE SIZE	NUMBER OF EXTRACTIONS	TIME OF EXTRACTIONS	COMMENTS
I. Static Tests A. Agitated Extraction Tests						
Toxicity Characteristic Leaching Procedure (1311)	0.1 N acetic acid solution, pH 2.9, for alkaline wastes 0.1 N sodium acetate buffer solution, pH 5.0, for non-alkaline wastes	20:1	9.5 mm	1	18 ±2 hours	Co-disposal scenario may not be appropriate; no allowance for structural integrity testing of monolithic samples
Extraction Procedure Toxicity Test (1310)	0.5 N acetic acid (pH-5.0)	16:1 during extraction 20:1 final dilution	9.5 mm	1	24 hours	High alkalinity samples may result in variable data
ASTM D3987-85 Shake Extraction of Solid Waste with Water	ASTM IV reagent water	20:1	As in environment (as received)	1	18 hours	Not validated for organics
California WET	0.2 M sodium citrate (pH-5.0)	10:1	2.0 mm	1	48 hours	Similar to EP, but sodium citrate makes test more aggressive
Ultrasonic Agitation Method for Accelerating Batch Leaching Test	Distilled water	4:1	Ground	1	30 minutes	New - little performance data

¹Bisson, D.L.; Jackson D.R.; Williams K.R.; and Grube W.E.. J. Air Waste Manage. Assoc., 41: 1348-1354.

Example Extraction Tests (continued)

TEST METHOD	LEACHING FLUID	LIQUID:SOLID RATIO	MAXIMUM PARTICLE SIZE	NUMBER OF EXTRACTIONS	TIME OF EXTRACTIONS	COMMENTS
Alternative TCLP for Construction, Demolition and Lead Paint Abatement Debris ²	TCLP acetic acid solutions	20:1	<9.5	1	8 hours	Uses heat to decrease extraction time
Extraction Procedure for Oily Waste (1330)	Soxhlet with THF and toluene EP on remaining solids	100g:300mL 20:1	9.5 mm	3	24 hours (EP)	
Synthetic Precipitation Leaching Procedure (1312)	#1 Reagent water to pH 4.2 with nitric and sulfuric acids (60/40) #2 Reagent water to pH 5.0 with nitric and sulfuric acids (60/40)	20:1	9.5 mm	1	18±2 hours	ZHE option for organics
Equilibrium Leach Test	Distilled water	4:1	150 mm	1	7 days	Determines contaminants that have been insolubilized by solidification
B. Non-Agitated Extraction Tests						
Static Leach Test Method (material characteristic centre-1)	Can be site specific, 3 standard leachates: water, brine, silicate/bicarbonate	VOL/surface 10cm	40 mm ² surface area	1	>7 days	Series of optional steps increasing complexity of analysis

²Olcres, R.; A Representative Sampling and Alternative Analytical Toxic Characteristic Leachate Procedure Method for Construction, Demolition, and Lead Paint Abatement Debris Suspected of Containing Leachable Lead, Appl. Occup. Environ. Hyg. 11(1), January 1996.

Example Extraction Tests (continued)

TEST METHOD	LEACHING FLUID	LIQUID:SOLID RATIO	MAXIMUM PARTICLE SIZE	NUMBER OF EXTRACTIONS	TIME OF EXTRACTIONS	COMMENTS
High Temperature Static Leach Tests Method (material characterization centre-2)	Same as MCC-1 (conducted at 100°C)	VOL/Surface 10 cm	40 mm ² Surface Area	1	>7 Days	Series of optional steps increasing complexity of analysis
		C. Sequential Chemical Extraction Tests				
Sequential Extraction Tests	0.04 m acetic acid	50:1	9.5 mm	15	24 hours per extraction	
		D. Concentration Build-Up Test				
Sequential Chemical Extraction	5 leaching solutions of increasing acidity	Varies from 16.1 to 40.1	150 mm	5	Varies 3 or 14 days	Examines partitioning of metals into different fractions or chemicals forms
Standard Leach Test, Procedure C (Wisconsin)	DI water SYN Landfill	10:1, 5:1 7.5:1	As in environment	3	3 or 14 days	Sample discarded after each leach, new sample added to existing leachate
		<u>II. Dynamic Tests (Leaching Fluid Renewed)</u>				
		A. Serial Batch (Particle)				
Multiple Extraction Procedure (1320)	Same as EP TOX, then with synthetic acid rain (sulfuric acid, nitric acid in 60:40% mixture)	20:1	9.5 mm	9 (or more)	24 hours per extraction	
Monofill Waste Extraction Procedures	Distilled/ deionized water or other for specific site	10:1 per extraction	9.5 mm or monolith	4	18 hours per extraction	

Example Extraction Tests (continued)

TEST METHOD	LEACHING FLUID	LIQUID:SOLID RATIO	MAXIMUM PARTICLE SIZE	NUMBER OF EXTRACTIONS	TIME OF EXTRACTIONS	COMMENTS
Graded Serial Batch (U.S. Army)	Distilled water	Increases from 2:1 to 96:1	N/A	>7	Until steady state	
Sequential Batch Ext. Of Waste with Water ASTM D-4793-93	Type IV reagent water	20:1	As in environment	10	18 hours	
Use of Chelating Agent to Determine the Metal Availability for Leaching Soils and Wastes ³	Demineralized water with EDTA, sample to a final pH of 7±0.5	50 or 100	<300 µm	1	18, 24, or 48 hours	Experimental test based on Method 7341
		B. Flow Around Tests				
IAEA Dynamic Leach Test (International Atomic Energy Agency)	DI water/site water	N/A	One face prepared	>19	>6 months	
Leaching Tests on Solidified Products ⁴	0.1N acetic acid	20:1 (Procedure A) 2:1 (6 hrs.) & 10:1 (18 hrs.) (Procedure B)	0.6 µm-70 µm	1	24 hours	S/S technologies most valid when applied to wastes contaminated by organic pollutants

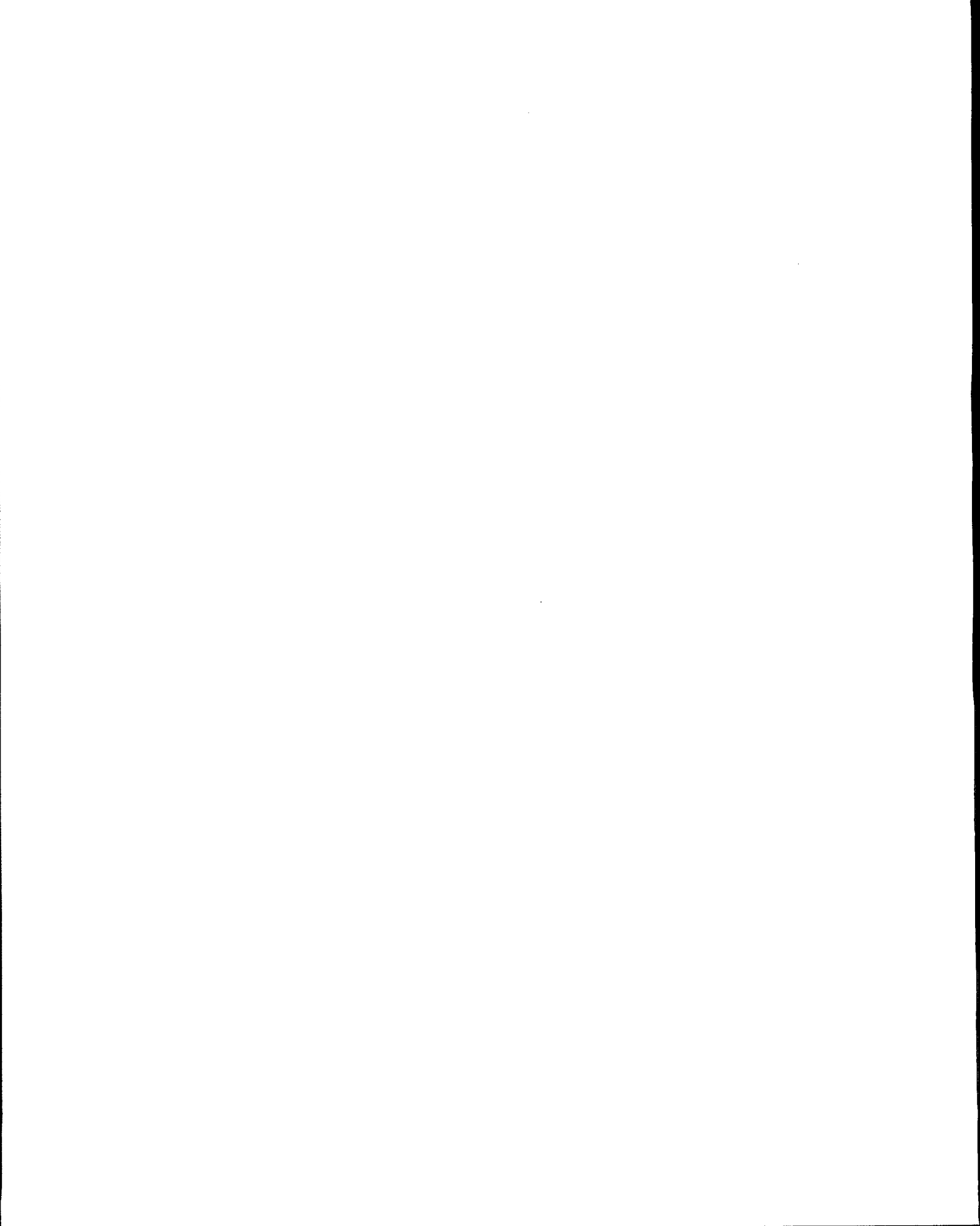
³Garrabrants, A.C. and Koson, D.S.; Use of Chelating Agent to Determine the Metal Availability for Leaching from Soils and Wastes, unpublished.⁴Leaching Tests on Solidified Products; Gavasci, R., Lombardi, F., Polettine, A., and Sirini, P.

Example Extraction Tests (continued)

TEST METHOD	LEACHING FLUID	LIQUID:SOLID RATIO	MAXIMUM PARTICLE SIZE	NUMBER OF EXTRACTIONS	TIME OF EXTRACTIONS	COMMENTS
DLT	DI water	N/A	Surface washing	18	196 days	
C. Flow Through Tests						
ASTM D4874-95 Column Test	Type IV reagent water	One void volume		1	24 hours	
III. Other Tests						
MCC-5s Soxhlet Test (material characteristic center)	DI/site water	100:1	Out and washed	1	0.2 ml/min	
ASTM C1308-95 Accelerated Leach Test ⁵						Only applicable if diffusion is dominant leaching mechanism
Generalized Acid Neutralization Capacity Test	Acetic acid	20:1	Able to pass through an ASTM No. 40 sieve	1	48 hours	Quantifies the alkalinity of binder and characterizes buffering chemistry
Acid Neutralization Capacity	HNO ₃ , solutions of increasing strength	3:1	150 mm	1	48 hours per extraction	

⁵C1308-95 Accelerated Leach Test for Diffusive Releases from Solidified Waste and a Computer Program to Model Diffusive, Fractional Leaching from Cylindrical Wastes.

⁶Generalized Acid Neutralization capacity Test; Isenburg, J. and Moore, M.



INTREGRATING POLLUTION PREVENTION,
RECYCLING, AND TREATMENT
APPENDICES

Appendix I: Technical Assistance Organizations¹

ALABAMA

Alabama Department of Environmental Management

Special Projects-P2 Unit
P.O. Box 301463
Montgomery, AL 36130-1463
Phone: 334 213-4300
Fax: 334 213-4399

ALASKA

Alaska Department of Environmental Conservation

555 Cordova Street
Anchorage, AK 99501-2617
Phone: 907 269-7582
Fax: 907 269-7652

ARIZONA

Arizona Department of Environmental Quality

3033 North Central Avenue
Phoenix, AZ 85012
Phone: 602 207-4607
Fax: 602 207-4236

ARKANSAS

Arkansas Industrial Development Commission

One State Capitol Mall
Little Rock, AR 72201
Phone: 501 682-7325
Fax: 501 682-7341

CALIFORNIA

California Energy Commission

1519 Ninth Street
Sacramento, CA 95814-5512
Phone: 916 654-4554
Fax: 916 663-7832

California Integrated Waste Management Board Waste Prevention and Market Development Division

8800 Cal Center Drive
Mail Station 20
Sacramento, CA 95826
Phone: 916 255-2320
Fax: 916 255-2573

California Manufacturing Technology Center

13430 Hawthorne Boulevard
Hawthorne, CA 90250
Phone: 310 355-3060
Fax: 310 676-8630

California State Department of Toxic Substances Control Office of Pollution Prevention and Technology Development

P.O. Box 806
Sacramento, CA 95812-0806
Phone: 916 322-1815
Fax: 916 327-4494

¹This information was excerpted from the Directory of State and Local Pollution Prevention Programs which is published by the National Pollution Prevention Roundtable, 2000 P Street, NW., Washington, DC, 20036 (Phone: 202 466-P2P2) and available online at es.inel.gov/nppr_yps.html.

Appendix I: Technical Assistance Organizations (cont.)

**Pollution Prevention Center
Institute for Research and Technical
Assistance**

2800 Olympic Boulevard, Suite 101
Santa Monica, CA 90404

Phone: 310 453-0450
Fax: 310 453-2660

**University of California - Los Angeles
P2 Center**

3250 Public Policy Building
P.O. Box 951656
Los Angeles, CA 90095

Phone: 310 825-2654
Fax: 310 206-3906

COLORADO

**Colorado Department of Public Health and
Environment**

Pollution Prevention Unit

4300 Cherry Creek Drive South
Denver, CO 80222

Phone: 303 692-3003
Fax: 303 782-4969

**Mid-American Manufacturing Technology
Center Colorado Regional Office**

Rockwell Hall
Colorado State University
Fort Collins, CO 80523

Phone: 303 224-3744

CONNECTICUT

**Connecticut Department of Environmental
Protection**

79 Elm Street
Hartford, CT 06106-5122

Phone: 203 424-3297
Fax: 203 566-4924

**Connecticut State Technology Extension
Program**

170 Middle Turnpike
Storrs, CT 06269-2041

Phone: 203 486-2585

**Connecticut Technical Assistance Program
(ConnTAP)**

50 Columbus Boulevard, Fourth Floor
Hartford, CT 06106

Phone: 203 241-0777
Fax: 203 244-2017

DELAWARE

**Delaware Department of Natural Resources
and Environmental Conservation
Pollution Prevention Program**

P.O. Box 1401
89 Kings Highway
Dover, DE 19903

Phone: 302 739-3822
Fax: 302 739-6242

**Delaware Manufacturing Alliance
Delaware Technology Park**

One Innovation Way, Suite 301
Newark, DE 19711

Phone: 302 452-2522
Fax: 302 452-1101

Appendix I: Technical Assistance Organizations (cont.)

FLORIDA

Florida Department of Environmental Resource Management

Pollution Prevention Program
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Phone: 904 488-0300
Fax: 904 921-8061

GEORGIA

Georgia Department of Natural Resources

205 Butler Street, SE., Suite 1066
Atlanta, GA 30334

Phone: 404 657-8828
Fax: 404 657-7379

Georgia Department of Natural Resources Pollution Prevention Assistance Division

Seven Martin Luther King, Jr. Drive,
Suite 450
Atlanta, GA 30334

Phone: 404 651-5120
Fax: 404 651-5130

Georgia Manufacturing Extension Alliance Georgia Institute of Technology

223 O'Keefe Building
Atlanta, GA 30332

Phone: 404 894-8989
Fax: 404 853-9172

University of Georgia

Dawson Hall, Room 307
Athens, GA 30602

Phone: 706 542-4887
Fax: 706 524-4890

HAWAII

State of Hawaii Department of Health Environmental Management Division

919 Ala Moana Boulevard
Honolulu, HI 96814

Phone: 808 586-4373
Fax: 808 586-7509

IDAHO

Idaho Division of Environmental Quality Prevention and Certification Bureau

1410 North Hilton
Boise, ID 83706

Phone: 208 334-5860
Fax: 208 334-0576

ILLINOIS

Chicago Manufacturing Center HWRIC- Clean Manufacturing Program

Homan Square
3333 West Arthington
Chicago, IL 60624

Phone: 312 265-2180
Fax: 312 265-8336

Illinois Department of Commerce and Community Affairs

620 East Adams Street, Third Floor
Springfield, IL 62701

Phone: 217 785-6192
Fax: 217 785-6328

Illinois Environmental Protection Agency Office of Pollution Prevention

2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276

Phone: 217 782-8700
Fax: 217 782-9142

Appendix I: Technical Assistance Organizations (cont.)

Illinois Hazardous Waste Research and Information Center

One East Hazelwood Drive
Champaign, IL 61820
Phone: 217 333-8940
Fax: 217 333-8944

INDIANA

Indiana Department of Environmental Management

Office of P2 and Technical Assistance
100 North Senate Avenue
P.O. Box 6015
Indianapolis, IN 46206-6015
Phone: 317 232-8172
Fax: 317 233-5627

Indiana P2 and Safe Materials Institute

1291 Cumberland Avenue, Suite C1
West Lafayette, IN 47906
Phone: 317 494-6450
Fax: 317 494-6422

IOWA

Iowa Department of Natural Resources

Waste Reduction Assistance Program
Wallace State Office Building
Des Moines, IA 50319-0034
Phone: 515 281-8499
Fax: 515 281-8895

Iowa Manufacturing Technology Center

2006 South Ankeny Boulevard
ATC Building, 3E
Ankeny, IA 50021
Phone: 515 965-7040
Fax: 515 965-7050

Iowa Waste Reduction Center

University of Northern Iowa
Cedar Falls, IA 50614-0185
Phone: 319 273-2079
Fax: 319 273-2926

KANSAS

Kansas Department of Health and Environment

Office of Pollution Prevention
Building 283
Forbes Field
Topeka, KS 66620
Phone: 913 296-6603
Fax: 913 296-3266

Kansas State University P2 Institute

133 Ward Hall
Manhattan, KS 66506
Phone: 913 532-6501
Fax: 913 532-6952

Mid-American Manufacturing Technology Center

10561 Barkley, Suite 602
Overland Park, KS 66208
Phone: 913 649-4333
Fax: 913 649-4498

University of Kansas

Continuing Education Building
Lawrence, KS 66045-2608
Phone: 913 864-3968
Fax: 913 864-5827

Appendix I: Technical Assistance Organizations (cont.)

KENTUCKY

Kentucky Business Environmental Assistance Program

227 Business and Economic Building
Lexington, KY 40506-0034

Phone: 606 257-1131

Fax: 606 323-1907

Kentucky P2 Center

University of Louisville
Academic Building, Room 420
Louisville, KY 40292

Phone: 502 852-0965

Fax: 502 852-0964

Kentucky Technology Service

P.O. Box 1125
Lexington, KY 40589

Phone: 606 252-7801

Fax: 606 252-7900

LOUISIANA

Louisiana Department of Environmental Quality

P.O. Box 82263
Baton Rouge, LA 70884

Phone: 504 765-0739

Fax: 504 765-0742

Louisiana Technical Assistance Program University of New Orleans

Engineering Building, Room 804
New Orleans, LA 70148

Phone: 504 286-6644

Fax: 504 286-5586

MAINE

Maine Department of Environmental Protection

State House Station, #17
Augusta, ME 04333

Phone: 207 287-2811

Fax: 207 287-7826

Maine State Planning Office Waste Management and Recycling Program

38 State House Station
Augusta, ME 04333

Phone: 207 287-3261

Fax: 207 287-6489

MARYLAND

Maryland Department of the Environment

2500 Broening Highway
Baltimore, MD 21224

Phone: 410 631-4119

Fax: 410 631-4477

Maryland Manufacturing Modernization Network

Maryland Department of Economic Development

Division of Business
217 East Redwood Street
Baltimore, MD 21202

Phone: 410 333-0206

Fax: 410 333-1836

Maryland Technology Extension Service

2104 Potomac Building-092
University of Maryland
College Park, MD 20742

Phone: 301 405-3883

Appendix I: Technical Assistance Organizations (cont.)

MASSACHUSETTS

Massachusetts Department of Environmental Protection

One Winter Street
Boston, MA 02202
Phone: 508 792-7962, Ext. 3775
Fax: 508 792-7621

Massachusetts Executive Office of Environmental Affairs Office of Technical Assistance for Toxics Use Reduction

100 Cambridge Street
Boston, MA 02202
Phone: 617 727-3260
Fax: 617 727-3827

Massachusetts Manufacturing Partnership Bay State Skills Corporation

101 Summer Street, Fourth Floor
Boston, MA 02110
Phone: 617 292-5100

Toxics Use Reduction Institute University of Massachusetts at Lowell

One University Avenue
Lowell, MA 01854-2881
Phone: 508 934-3275
Fax: 508 934-3050

MICHIGAN

Industrial Technology Institute Midwest Manufacturing Technology Center Energy and Environmental Program

P.O. Box 1485
2901 Hubbard Road
Ann Arbor, MI 48106
Phone: 313 769-4234
Fax: 313 769-4021

Michigan Department of Environmental Quality Environmental Services Division Pollution Prevention Section

P.O. Box 30457
Lansing, MI 48909-7957
Phone: 517 373-2731
Fax: 517 335-4729

Michigan Technical University Center for Clean Industrial Treatment

1400 Townsend
Houghton, MI 49931
Phone: 906 487-3143
Fax: 906 487-3292

University of Michigan

Dana Building
430 East University
Ann Arbor, MI 48109-1115
Phone: 313 936-2637
Fax: 313 936-2195

MINNESOTA

Minnesota Office of Environmental Assistance

520 Lafayette Road, Second Floor
Saint Paul, MN 55155
Phone: 612 215-0296
Fax: 612 297-8709

Minnesota Pollution Control Agency Pollution Prevention Program

520 Lafayette Road
Saint Paul, MN 55155
Phone: 612 296-8643
Fax: 612 297-8676

Appendix I: Technical Assistance Organizations (cont.)

Minnesota Technology, Inc.

400 Mill Place
111 Third Avenue, South
Minneapolis, MN 55401
Phone: 612 672-3446
Fax: 612 339-5214

Minnesota Technology Inc. Upper Midwest Manufacturing Technology Center

111 Third Avenue South, Suite 400
Minneapolis, MN 55401
Phone: 612 654-5201

MISSISSIPPI

Mississippi Department of Environmental Quality Waste Reduction and Waste Minimization Program

P.O. Box 10385
Jackson, MS 39289-0385
Phone: 601 961-5171
Fax: 601 961-5376

MISSOURI

Missouri Department of Natural Resources Technical Assistance Program Pollution Prevention Unit

P.O. Box 176
Jefferson City, MO 65102
Phone: 314 526-6627
Fax: 314 526-5808

MONTANA

Montana Pollution Prevention Program Montana State University Extension Service

109 Taylor Hall
Bozeman, MT 59717
Phone: 406 994-3451
Fax: 406 994-5417

Montana Small Business Assistance Programs Air Quality Program

P.O. Box 200501
Helena, MT 59620-0501
Phone: 406 444-2960
Fax: 406 433-1872

State of Montana Water Quality Division

P.O. Box 200901
Helena, MT 59620
Phone: 406 444-7343
Fax: 406 444-1374

NEBRASKA

Nebraska Department of Environmental Quality Office of Pollution Prevention

P.O. Box 98922
Lincoln, NE 68509-8922
Phone: 402 471-2266
Fax: 402 471-2909

Nebraska Small Business Development Center

1313 Farnham Street, Suite 312
Omaha, NE 68182-0248
Phone: 402 595-2381
Fax: 402 595-2385

University of Nebraska Biological Systems Engineering

253 Chase Hall
Lincoln, NE 68583-0726
Phone: 402 472-8656
Fax: 402 472-6337

Appendix I: Technical Assistance Organizations (cont.)

NEVADA

Nevada Small Business Development
Center
Business Environmental Program, MS-032
University of Nevada at Reno

Reno, NV 89557-0100

Phone: 702 784-1717

Fax: 702 784-1375

NEW HAMPSHIRE

New Hampshire Department of
Environmental Services

P.O. Box 95

Concord, NH 00302-0095

Phone: 603 271-6398

Fax: 603 271-2867

NEW JERSEY

New Jersey Department of Environmental
Protection
Office of Pollution Prevention, CN423

401 East State Street

Trenton, NJ 08625

Phone: 609 777-0518

Fax: 609 777-1330

New Jersey Technical Assistance Program
for Industrial Pollution Prevention (NJTAP)
New Jersey Institute of Technology

CEES Building University Heights

Newark, NJ 07102-1982

Phone: 201 596-5864

Fax: 201 596-6367

NEW MEXICO

New Mexico Economic Development

1100 Saint Francis Drive

Santa Fe, NM 87503

Phone: 505 827-0563

Fax: 505 271-1317

New Mexico Office of Energy, Minerals,
and Natural Resources

2040 South Pacheco Street

Santa Fe, NM 87505

Phone: 505 827-5993

Fax: 505 438-3855

New Mexico Office of the Secretary
Environment Department

P.O. Box 26110

Santa Fe, NM 87502

Phone: 505 827-0677

Fax: 505 271-2846

New Mexico Industry Network
Corporations

1601 Randolph Road, SE., Suite 210

Albuquerque, NM 87106

Phone: 505 272-7800

Fax: 505 272-7810

NEW YORK

Hudson Valley Manufacturing Outreach
Center

Hudson Valley Technology Development
Center

300 Westgate Business Center, Suite 210

Fishkill, NY 12524

Phone: 914 896-6934

Appendix I: Technical Assistance Organizations (cont.)

**Manufacturing Outreach Center of New
York - Southern Tier
UniPEG**

61 Court Street, Sixth Floor
Binghamton, NY 13901

Phone: 607 774-0022
Fax: 607 774-0026

**New York Manufacturing Extension
Partnership**

385 Jordan Road
Troy, NY 12180-8347

Phone: 518 283-1010
Fax: 518 283-1212

**New York State Environmental Facilities
Corporation**

50 Wolf Road, Room 547
Albany, NY 12205

Phone: 518 457-9135
Fax: 518 485-8494

**New York City Manufacturing Outreach
Center
NY ITAC**

253 Broadway, Room 302
New York, NY 10007

Phone: 212 240-6920
Fax: 212 240-6879

**New York State Department of
Environmental Conservation
Pollution Prevention Unit**

50 Wolf Road
Albany, NY 12233-8010

Phone: 518 457-7267
Fax: 518 457-2570

**Western New York Tech Development
Center**

1576 Sweet Home Road
Amherst, NY 14228

Phone: 716 636-3626
Fax: 716 636-3630

NORTH CAROLINA

**North Carolina Department of
Environment, Health, and Natural
Resources
Division of Pollution Prevention and
Environmental Assistance**

P.O. Box 29569
Raleigh, NC 27626-9569

Phone: 919 715-6500
Fax: 919 715-6794

**University of North Carolina
Small Business Environmental Affairs
Office**

305 Kennedy Building
Charlotte, NC

Phone: 704 547-3968
Fax: 704 547-3216

NORTH DAKOTA

**North Dakota Department of Health
Environmental Health Section**

P.O. Box 5520
Bismarck, ND 58502-5200

Phone: 701 328-5150
Fax: 701 328-5200

**University of North Dakota
Energy and Environmental Research Center**

P.O. Box 9018
Grand Forks, ND 58202-9018

Phone: 701 777-5000
Fax: 701-777-5181

Appendix I: Technical Assistance Organizations (cont.)

OHIO

Great Lakes Manufacturing Technology Center (GLMTC)

Prospect Park Building
4600 Prospect Avenue
Cleveland, OH 44103-4314

Phone: 216 432-5350
Fax: 216 432-5314

Ohio Environmental Protection Agency Office of Pollution Prevention

1800 Watermark Drive
P.O. Box 1049
Columbus, OH 43216-1049

Phone: 614 644-2930
Fax: 614 728-2329

Plastics Technology Deployment Center

Prospect Park Building
4600 Prospect Avenue
Cleveland, OH 44103

Phone: 216 432-5340
Fax: 216 361 -2088

OKLAHOMA

Oklahoma Alliance for Manufacturing Excellence, Inc.

252 South Main, Suite 500
Tulsa, OK 74103

Phone: 918 592-0722
Fax: 918 592-1417

Oklahoma Department of Environmental Quality Pollution Prevention Program

1000 NE. 10th Street
Oklahoma City, OK 73117-1212

Phone: 405 271-1400
Fax: 405 271-8425

OREGON

Oregon Department of Environmental Quality Toxics Use and Hazardous Waste Reduction Program

811 SW Sixth Avenue
Portland, OR 97204

Phone: 503 229-5946
Fax: 503 229-5850

PENNSYLVANIA

Northeast Pennsylvania Manufacturing Extension Program Manufacturers Resource Center

125 Goodman Drive
Bethlehem, PA 18015

Phone: 610 758-5599

Pennsylvania Department of Environmental Resources Source Reduction Program

P.O. Box 8472
Harrisburg, PA 17105-8472

Phone: 717 787-0540
Fax: 717 787-8926

Pennsylvania Technical Assistance Program Penn State University

117 Tech Center
University Park, PA 16802

Phone: 814 865-0427
Fax: 814 865-5909

Western Pennsylvania Manufacturing Extension Program

4516 Henry Street
Pittsburgh, PA 15213

Phone: 412 687-0200, Ext. 234

Appendix I: Technical Assistance Organizations (cont.)

RHODE ISLAND

**Rhode Island Department of
Environmental Management
Office of Strategic Planning and Policy**

235 Promenade Street
Providence, RI 02908

Phone: 800 CLEAN RI or 401 222-3434
Fax: 401 222-2591

**Rhode Island Economic Development
Corporation**

Seven Jackson Walkway
Providence, RI 02903

Phone: 401 277-2601
Fax: 401 277-2591

SOUTH CAROLINA

**South Carolina Department of Health and
Environmental Control
Center for Waste Minimization**

2600 Bull Street
Columbia, SC 29201

Phone: 803 734-4761
Fax: 803 734-9934

**University of South Carolina Institute of
Public Affairs
Hazardous Waste Management Research
Fund**

937 Assembly Street
Columbia, SC 29208

Phone: 803 777-8157
Fax: 803 777-4575

SOUTH DAKOTA

**South Dakota Department of Environment
and Natural Resources**

Joe Foss Building
523 East Capitol Avenue
Pierre, SD 57501-3181

Phone: 605 773-4216
Fax: 605 773-4068

TENNESSEE

Tennessee Center for Industrial Services

226 Capitol Building, Suite 600
Nashville, TN 37219-1804

Phone: 615 974-3018
Fax: 615 974-1528

TEXAS

Dallas County Community College

12800 Abrams Road
Dallas, TX 75243-2199

Phone: 214 238-6905
Fax: 214 238-6467

**Texas Natural Resource Conservation
Commission
Office of Pollution Prevention and
Recycling (MC112)**

P.O. Box 13087
Austin, TX 78711-3087

Phone: 512 239-3166
Fax: 512 239-3165

**University of Texas at Arlington
Environmental Institute for Technology
Transfer**

P.O. Box 19050
Arlington, TX 76019

Phone: 817 273-2300
Fax: 817 794-5653

Appendix I: Technical Assistance Organizations (cont.)

UTAH

**Utah Department of Environmental Quality
Office of Planning and Public Affairs**

168 North 1950 West
P.O. Box 144810
Salt Lake City, UT 84114-4810
Phone: 801 536-4477
Fax: 801 536-4401

**Weber State University
Automotive Technology**

Ogden, Utah 84408-6318
Phone: 801 626-6318
Fax: 801 626-7917

VERMONT

**Vermont Department of Environmental
Conservation
Pollution Prevention Division
Environmental Assistance Division**

West Office Building
103 South Main Street
Waterbury, VT 05671-0404
Phone: 802 241-3888
Fax: 802 241-3296

VIRGINIA

A.I. Philpott Manufacturing Center

231 East Church Street
Martinsville, VA 24112
Phone: 703 666-8890

**Virginia Department of Environmental
Quality
Office of Pollution Prevention**

P.O. Box 10009
Richmond, VA 23240-0009
Phone: 804 698-4545
Fax: 804 698-4346

WASHINGTON

**Washington State Department of Ecology
Hazardous Waste and Toxics Reduction
Program**

P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360 407-6086
Fax: 360 407-6989

WEST VIRGINIA

**West Virginia Division of Environmental
Protection
Office of Water Resources
Pollution Prevention Services**

2006 Robert C. Byrd Drive
Beckley, WV 25801-8320
Phone: 304 484-6269
Fax: 304 558-2780

WISCONSIN

**University of Wisconsin
Extension SHWEC**

1304 South 70th Street
West Allis, WI 53214
Phone: 414 475-2845
Fax: 414 475-3777

**Wisconsin Department of Natural
Resources
Hazardous Waste Minimization Program**

P.O. Box 7921
Madison, WI 53707
Phone: 608 267-3763
Fax: 608 267-2768

Appendix I: Technical Assistance Organizations (cont.)

**Wisconsin Department of Natural
Resources
Pollution Prevention Program**

P.O. Box 7921, TS/6
101 South Webster
Madison, WI 53707

Phone: 608 267-3125
Fax: 608 267-0496

WYOMING

**Wyoming Department of Environmental
Quality
Solid and Hazardous Waste Division**

122 West 25th Street
Cheyenne, WY 82002

Phone: 307 777-6105
Fax: 307 777-5973

GUAM

Guam Environmental Protection Agency

P.O. Box 22439
Guam Main Facility
Barrigada, Guam 96921

Phone: 671 472-8863
Fax: 671 477-9402

PUERTO RICO

**Puerto Rico Environmental Technology
Assistance**

P.O. Box 40285
San Juan, Puerto Rico 00940

Phone: 809 765-7517, Ext. 381
Fax: 809 765-6853

Appendix II: Trade Associations

GENERAL

American Society for Testing and Materials

100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

Phone: 610 832-9500

Fax: 610 832-9555

Home page: www.astm.org

Center for Waste Reduction Technologies

534 East 47th Street, 12th Floor
New York, NY 10017

Phone: 212 705-7407

Fax: 212 838-8274

Home page: www.aiche.org/docs/cwrt

Mid-Continent Recycling Association

P.O. Box 5520
Bismarck, ND 58502-5520

Phone: 701 221-5170

Fax: 701 221-5200

National Recycling Coalition

1727 King Street, Suite 105
Alexandria, VA 22314-2720

Phone: 703 683-9025

Fax: 703 683-9026

Northeast Recycling Council

139 Main Street, Suite 401
Brattleboro, VT 05301

Phone: 802 254-3636

Fax: 802 254-5870

Home page: www.nerc.org

Pacific Northwest Economic Region

First Interstate Center, Suite 1080
999 Third Avenue
Seattle, WA 98104

Phone: 206 464-7298

Fax: 206 464-6859

Home page: www.pnwer.org

Pacific Northwest Pollution Prevention Research Center

1326 Fifth Avenue, Suite 650
Seattle, WA 98101

Phone: 206 223-1151

Fax: 206 223-1165

Home page: pprc.pnl.gov/pprc

Southeast Recycling Market Council: Southeast Recyclers Market Exchange

P.O. Box 11468
Montgomery, AL 36111

Phone: 205 277-7050

Fax: 205 277-7080

Southwest Public Recycling Association

P.O. Box 27210
Tucson, AZ 85726

Phone: 602 791-4069

Fax: 602 791-5417

Western States Recycling Coalition Council of State Governments

121 Second Street
San Francisco, CA 94105

Phone: 415 974-6422

Fax: 415 974-1747

Appendix II: Trade Associations (cont.)

ALUMINUM

Aluminum Association

900 19th Street, NW., Suite 300
Washington, DC 20006

Phone: 202 862-5100

Fax: 202 862-5164

Home page: <www.aluminum.org>

ASPHALT

Asphalt Recycling and Reclaiming Association

Three Church Circle, Suite 250
Annapolis, MD 21401

Phone: 410 267-0023

Fax: 410 267-7546

Home page: <www.arra.org>

CHEMICALS

Chemical Manufacturers Association

1300 Wilson Boulevard
Arlington, VA 22209

Phone: 703 741-5000

Fax: 703 741-6242

Home page: <www.cmahq.com>

The National Association of Chemical Recyclers

1200 G Street, Suite 800
Washington, DC 20005

Phone: 202 434-8740

Fax: 202 434-8741

Home page: <www.bismarck.com/nacr/nacr.html>

Synthetic Organic Chemical Manufacturers Association

1100 New York Avenue, Suite 1090
Washington, DC 20005

Phone: 202 414-4100

Fax: 202 289-8584

Home page: <www.socma.com>

COAL ASH

American Coal Ash Association

2760 Eisenhower Avenue, Suite 304
Alexandria, VA 22314-4553

Phone: 703 317-2400

Fax: 703 317-2409

Home page: <www.acaa-usa.org>

FERROUS METALS

Institute of Scrap Recycling Industries

1325 G Street, NW., Suite 1000
Washington, DC 20005-3104

Phone: 202 737-1770

Fax: 202 626-0900

Home page: <www.isri.org>

American Iron and Steel Institute

1101 17th Street, NW., Suite 1300
Washington, DC 20036

Phone: 202 452-7112

Fax: 202 463-6573

Home page: <www.steel.org>

American Foundrymen's Society, Inc.

505 State Street
Des Plaines, IL 60016-8399

Phone: 847 824-0181 or 800 537-4237

Fax: 847 824-7848

Home page: <www.afsinc.org>

Appendix II: Trade Associations (cont.)

Container Recycling Institute

1400 16th St., NW., Suite 250
Washington, DC 20036

Phone: 202 797-6839

Fax: 202 797-5411

Home page: www.io.org/~boo4env/cpr/intro.htm

Recycling Institute

680 Andersen Drive
Pittsburgh, PA 15220-2700

Phone: 412 922-2772 or 800 876-7274

Fax: 412 922-3213

Home page: www.recycle-steel.org

FOOD AND YARD WASTE

Compost Council

114 South Pitt Street
Alexandria, VA 22314

Phone: 703 739-2401

Fax: 703 739-2407

Home page: www.composter.com

Grocery Manufacturers of America

1010 Wisconsin Avenue, NW., Suite 900
Washington, DC 20007

Phone: 202 337-9400

Fax: 202 337-4508

Home page: www.gmabrands.com

National Composting Program (US Conference of Mayors)

1620 I Street, NW.
Washington, DC 20006

Phone: 202 293-7330

Fax: 202 429-0422

Home page: www.usmayors.org

National Food Processors Association

1401 New York Avenue, NW., Suite 400
Washington, DC 20005

Phone: 202 639-5900

Fax: 202 639-5932

Home page: www.nfpa-food.org

OIL

American Petroleum Institute

1220 L Street, NW.
Washington, DC 20005

Phone: 202 682-8000

Fax: 202 682-8031

Home page: www.api.org

National Oil Recyclers Association

12429 Cedar Road, Suite 26
Cleveland, Ohio 44106-3172

Phone: 216-791-7316

Fax: 216-791-6047

Home page: www.noraoil.com

United Association of Used Oil Services

318 Newman Road
Sebring, FL 33870

Phone: 941 655-3880 or 800 877-4356

Fax: 941 655-3713

PACKAGING

Corrugated Packaging Council
2850 Golf Road
Rolling Meadow, IL 60008

Phone: 847 364-9600 or 800 879-9777

Fax: 847 364-9639

Home page: www.corrugated.com

Appendix II: Trade Associations (cont.)

Institute of Packaging Professionals

481 Carlisle Drive
Herndon, VA 22070-4819
Phone: 703 318-8970 or 800 432-4085
Fax: 703 318-0310
Home page: <www.packinfo-world.org>

National Wooden Pallet and Container Association

1800 North Kent Street, Suite 911
Arlington, VA 22209-2109
Phone: 703 527-7667
Fax: 703 527-7717
Home page: <www.nwpca.com>

PAPER

American Forest and Paper Association

1111 19th Street, NW, Suite 800
Washington, DC 20036
Phone: 202 463-2700 or 800 878-8878
Fax: 202 463-2785
Home page: <www.afandpa.org>

Institute of Paper Science and Technology

500 10th Street, NW
Atlanta, GA 30318
Phone: 404 894-5726
Fax: 404 894-4778
Home page: <www.ipst.edu>

PLASTICS

American Plastics Council

1801 K Street, NW, Suite 701L
Washington, DC 20006
Phone: 202 974-5400 or 800 243-5790
Fax: 202 296-7119
Home page: <www.plasticsresource.com/apc>

RUBBER

Rubber Manufacturers Association

1400 K Street, NW, Suite 900
Washington, DC 20005
Phone: 202 682-4800
Fax: 202 682-4854
Home page: <www.rma.org>

TEXTILES

American Textile Manufacturers Institute

1130 Connecticut Avenue NW,
Suite 1200
Washington, DC 20036
Phone: 202 862-0541
Fax: 202 862-0570
Home page: <www.atmi.org>

Council for Textile Recycling Secondary Materials & Recycled Textiles, Inc.

7910 Woodmont Avenue, Suite 1212
Bethesda, MD 20814
Phone: 301 656-1077
Fax: 301 656-1079
Home page: <www.smartasn.org>

UTILITIES

Edison Electric Institute

701 Pennsylvania Avenue, NW
Washington DC 20004-2696
Phone: 202 508-5000
Fax: 202 508-5186
Home page: <www.eei.org>

Alabama Waste Materials Exchange

411 East Irvine Avenue
Florence, AL 35630
Phone: 205 764-6830

Appendix III: North American Materials Exchanges

**Alaska Materials Exchange
Alaska Department of Environmental
Conservation**

555 Cordova Street
Anchorage, AK 99501
Phone: 907 269-7586 or 800 510-2332

**Alberta Waste Materials Exchange
Alberta Research Council**

P.O. Box 8330
Edmonton, AB T6H 5X2
Canada
Phone: 403 465-3308
Home page: <www.awme.arc.ab.ca>

Arizona Waste Exchange

4725 East Sunrise Drive, Suite 215
Tucson, AZ 85718
Phone: 602 299-7716

Arizona Resource Exchange Program

1331 East Fifth Street
P.O. Box 210049
Tucson, AZ 85721-0049
Phone: 520 621-1266

**Arkansas Economic Development
Commission**

One Capitol Mall, Room 4B215
Little Rock, AR 72201
Phone: 501 682-7325
Home page: <www.adec.state.ar.us>

Atlantic Coastal Action Program

P.O. Box 6878, Station A
Saint John, NB E20 4S3
Canada

Phone: 506 652-2227

**Berkshires Materials Exchange
Center for Ecological Technology**

112 Elm Street
Pittsfield, MA 01201
Phone: 413 445-4556

Business Materials Exchange

136 West Grand Avenue, Suite 100
Beloit, WI 53511
Phone: 608 364-1131 or 800 364-3233
Home page: <www.wr.net/bmex/index.htm>

**California Materials Exchange
California Integrated Waste Management
Board**

8800 Cal Center Drive
Sacramento, CA 95826
Phone: 916 255-2369
Home page: <www.ciwmb.ca.gov/mrt/calmax/calmax.htm>

**California Waste Exchange
Department of Toxic Substances Control**

P.O. Box 806
Sacramento, CA 95812-0806
Phone: 916 322-4742
Home page: <www.calepa.cahwnet.gov/dtsdocs/cawastex.txt>

Appendix III: North American Materials Exchanges (cont.)

Canadian Waste Materials Exchange ORTECH Corporation

2395 Speakman Drive
Mississauga, ON L5K 1B3
Canada

Phone: 905 822-4111, Ext. 265

Chicago Board of Trade (CBOT) Recyclables Exchange

141 West Jackson Blvd.
Chicago, IL 60604-2994

Phone: 312 435-7223

Home page: www.cbot.com/recyclables

Commercial Materials Exchange

1583 Banks Road
Margate, FL 33063

Phone: 954 984-0701

EnviroShare Materials Exchange Hall County Resource Recovery

Post Office Drawer 1435
Gainesville, GA 30503

Phone: 770 535-8284

Home page: www.enviroshare.org

Hawaii Materials Exchange

P.O. Box 121
Wailuku, HI 96793

Phone: 808 667-7744 or 888 991-4000

Home page: maui.net/~mrghimex/himex1.html

Hudson Valley Materials Exchange

207 Milton Turnpike
Milton, NY 12547

Phone: 914 795-5507

Illinois Industrial Materials Exchange Illinois Environmental Protection Agency (34)

2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276

Phone: 217 782-0450

Home page: www.epa.state.il.us/imes.html

Indiana Materials Exchange

P.O. Box 2931
125 West South Street
Indianapolis, IN 46206-2931

Phone: 614 397-7675 or 800 968-8764

Home page: www.ai.org/idem/imex

Indiana Waste Exchange c/o Recycler's Trade Network, Inc.

P.O. Box 454
Carmel, IN 46032

Phone: 317 574-6505

Industrial Materials Exchange

First Interstate Center
999 Third Avenue, Suite 700
Seattle, WA 98104-4039

Phone: 206 296-4899/3968

Home page: www.metrokc.gov/hazwaste/imex

Industrial Materials Exchange, Inc.

1001 SW. Second Avenue, Suite 234
Boca Raton, FL 33487

Phone: 800 541-7156

Industrial Materials Exchange Service

P.O. Box 19276, #34
Springfield, IL 62794-9276

Phone: 217 782-0450

Appendix III: North American Materials Exchanges (cont.)

Industrial Waste Recycling and Prevention Program

Long Island City Business Development Corps

29-10 Thomson Avenue, Ninth Floor
Long Island City, NY 11101

Phone: 718 786-5300, Ext. 24

Iowa Waste Reduction Center

By-Product and Waste Search Service

University of Northern Iowa

75 BRC
Cedar Falls, IA 50614-0185

Phone: 319 273-2079 or 800 422-3109

Home page: <www.recycleiowa.org/tech/bawss.html>

Intercontinental Waste Exchange

5200 Town Center Circle, Suite 303
Boca Raton, FL 33486

Phone: 800 541-0400

Kansas Materials Exchange

P.O. Box 152
Hutchinson, KS 67504-0152

Phone: 316 662-0551

Kentucky Department of Environmental Protection, Division of Waste Management

18 Riley Road
Frankfort, KY 40601

Phone: 502 564-6716

Kentucky Industrial Materials Exchange Kentucky Pollution Prevention Center

420 Academic Building
University of Louisville
Louisville, KY 40292

Phone: 502 852-0965 or 800 334-8635,
Ext. 0965

Home page: <www.louisville.edu/org/kppc>

La Bourse Québécoise des Matières Secondaires

900 Place D'Youville
Bureau 210
Québec, PQ G1R 3P7
Canada

Phone: 418 528-0908 or 800 668-6686

Homepage: <www.recycquebec.gouv.qc.ca/english/en_bulle_index.html>

Maine Materials Exchange

93 Maquoit Drive
Freeport, ME 04032

Phone: 207 865-6621

Manitoba Waste Exchange Resource Conservation Manitoba

2-70 Alberta Street
Winnipeg, MB R3B 1E7
Canada

Phone: 204 942-4207

Home page: <www.winnipeg.freenet.mb.ca/rcm/index.html>

Material Exchange

1037 State Street
Bridgeport, CT 06605

Phone: 203 335-3452

Appendix III: North American Materials Exchanges (cont.)

**Minnesota Materials Exchange
Minnesota Office of Environmental
Assistance**

520 Lafayette Road, Second Floor
St. Paul, MN 55155-4100
Phone: 612 215-0216

**Minnesota Materials Exchange Alliance
Minnesota Technical Assistance Program**

1313 Fifth Street, Suite 307
Minneapolis, MN 55414
Phone: 612 627-4646 or 800 247-0015
Home page: <www.umn.edu/mntap>

**Missouri Environmental Improvement
Authority**

325 Jefferson Street
Jefferson City, MO 65101
Phone: 314 751-4919

Mississippi Technical Assistance Program

P.O. Box 9595
Mississippi State, MS 39762
Phone: 601 325-8454
Home page: <www.de.msstate.edu/misatap>

**Montana Industrial Waste Exchange
Montana Chamber of Commerce**

P.O. Box 1730
Helena, MT 59624
Phone: 406 442-2405

**Montana Materials Exchange
MS Extension Service**

Taylor Hall
Bozeman, MT 59717
Phone: 406 994-3451 or 888 678-6872
Home page: <www.montana.edu/wwwated>

**National Association for the Exchange of
Industrial Resources**

560 McClure Street
Galesburg, IL 61401
Phone: 800 562-0955
Home page: <www.misslink.net/naeir/naeir.htm>

New Hampshire Materials Exchange

122 North Main Street
Concord, NH 03301
Phone: 603 224-5388 or 800 895-1930
Home page: <www.enviro-source.com>

**New Jersey Industrial Waste Information
Exchange**

50 West State Street, Suite 1110
Trenton, NJ 08608
Phone: 609 989-7888

New Mexico Material Exchange

Four Corners Recycling
P.O. Box 904
Farmington, NM 87499

Northeast Industrial Waste Exchange, Inc.

P.O. Box 2171
Annapolis, MD 21404
Phone: 410 280-2080

**Northeast Minnesota Waste Exchange
Western Lake Superior Sanitary District**

2626 Courtland Street
Duluth, MN 55806
Phone: 218 722-3336

Appendix III: North American Materials Exchanges (cont.)

Ohio's Materials Exchange (OMEx) c/o Waste Alternatives

P.O. Box 70
Mount Vernon, OH 43050
Phone: 888 718-6639
Home page: www.epa.state.oh.us/opp/recyc/omex.html

Oklahoma Waste Exchange Program Department of Environmental Quality Waste Management Division

1000 NE. 10th Street
Oklahoma City, OK 73117-1212
Phone: 405 271-7354
Home page: www.deq.state.ok.us

Olmsted County Material Exchange Olmsted County Public Works

2122 Campus Drive
Rochester, MN 55904
Phone: 507 285-8231

Ontario Waste Exchange ORTECH Corporation

2395 Speakman Drive
Mississauga, ON L5K 1B3
Canada
Phone: 905 822-4111, Ext. 358

Pacific Materials Exchange

1522 North Washington, Suite 202
Spokane, WA 99205
Phone: 509 325-0551

Puerto Rico Waste Exchange

West 339 Calderon Street
San Juan, PR 00926
Phone: 809 748-0433

Resource Exchange Network for Eliminating Waste

TNRCC (MC-112)
P.O. Box 13087
Austin, TX 78711-3087
Phone: 512 463-7773
Home page: www.tnrcc.state.tx.us/admin/topdoc/pd/002

Rocky Mountain Materials Exchange

999 18th Street, Suite 2750
Denver, CO 80202
Phone: 303 297-0180, Ext. 103
Home page: www.rmmex.com

Southeast Minnesota Materials Exchange

171 West Third Street
Winona, MN 55987
Phone: 507 457-6464
Home page: www.wwwwis.com/semrex

Southeast Waste Exchange Urban Institute University of North Carolina, Charlotte

9201 University City Boulevard
Charlotte, NC 28223-0001
Phone: 704 547-4289

Southern Waste Information Exchange

P.O. Box 960
Tallahassee, FL 32302
Phone: 904 386-6280 or
800 441-SWIX (441-7949)
Home page: www.enviroworld.com/SWIX

Appendix III: North American Materials Exchanges (cont.)

**Southwest Minnesota Materials Exchange
Nobels County/Environmental Services**

P.O. Box 757
Worthington, MN 56187
Phone: 507 372-8227

Tennessee Materials Exchange

226 Capitol Boulevard Building,
Suite 605
Nashville, TN 37219
Phone: 615 532-8881
Home page: <www.cis.utk.edu>

**Transcontinental Materials Exchange
Department of Civil Engineering
Louisiana State University**

Baton Rouge, LA 70803
Phone: 504 388-4594

TSDX Corporation

1667 Cole Boulevard, Suite 400
Golden, CO 80401
Phone: 303 202-6620
Home page: <www.tsdx.com/surplus>

Vermont Business Materials Exchange

P.O. Box 935
Brattleboro, VT 05302
Phone: 802 257-7505

Wastelink, Division of Tencon, Inc.

140 Wooster Pike
Milford, OH 45150
Phone: 513 248-0012

**Wisconsin Department of Natural
Resources Bureau of Solid and Hazardous
Waste Management**

101 South Webster Street
P.O. Box 7921
Madison, WI 53707-7921
Phone: 608 267-9523

Appendix IV: Publications, Online Resources, and Software

PUBLICATIONS AND ONLINE RESOURCES

The following are print and electronic sources of information about pollution prevention and waste reduction.

American Forest and Paper Association (AF&PA). AF&PA is the national trade association of the forest, paper, and wood products industries. It offers documents that may help you find buyers for wood and paper wastes. These documents include:

- **National Wood Recycling Directory.** This directory provides a nationwide listing of over 650 wood residue receiving centers. You can also search an on-line database of wood residue receiving centers at www.afandpa.org/recycling/wood/search.htm.
- **PaperMatcher: A Directory of Paper Recycling Mills.** This directory provides contact information for waste paper dealers, recycling centers, and mills consuming waste paper.

Contact AF&PA at 800 878-8878 (e-mail at: INFO@afandpa.ccmail.compuserve.com). A publications order form is available online at www.afandpa.org/publications/ic-gen.htm.

California Integrated Waste Management Board. This web site contains general waste prevention background and business waste reduction program overviews, fact sheets, and information about market development for recycled materials and waste reduction training.

Home page: www.ciwmb.ca.gov/mrt/wpw/wpmain.htm.

Center for Environmental Research Information (CERI). CERI technical documents on waste reduction include guides and manuals, summaries of pollution prevention opportunity assessments, and waste reduction alternatives for specific industry sectors. Examples of resources available from CERI include:

- **Facility Pollution Prevention Guide.** U.S. EPA, EPA600-R-92-088.
- **Primer/Financial Analysis/P2 Projects.** U.S. EPA, EPA600-R-93-059.

Industry-specific guides are available for many industries, including:

- Fabricated metals;
- Pharmaceuticals;
- Metal finishing; and
- Painted circuit boards.

Contact CERI at 513-569-7562 (e-mail at: ord.ceri@epamail.epa.gov) to request publications.

Home page: www.epa.gov/ttnrmrl/tmat.htm.

Enviro\$en\$e. Enviro\$en\$e is a federal P2 network created by integrating technical information from EPA, over 16 Federal agencies, the States through the National Pollution Prevention Roundtable, and industry. The system seeks to facilitate the sharing of technology and experience among manufacturers, government, and researchers. It includes a directory of federal, state, and local pollution prevention programs. Enviro\$en\$e enables users to exchange information with other environmental professionals, access online databases such as EPA's Solvent Alternatives Umbrella and Pollution Prevention Case Studies, obtain EPA publications, and conduct key-word searches.

Appendix IV: Publications, Online Resources, and Software (cont.)

Industry-specific information is included for the following industries:

- Commercial printing and graphic arts;
- Electronics assembly and manufacturing;
- Iron and steel foundries; and
- Metal finishing.

Enviro\$en\$e is accessible through either a modem at 703 908-2092 or the Internet at es.inel.gov.

National Pollution Prevention Roundtable. The National Pollution Prevention Roundtable (NPPR) is the largest membership organization in the United States devoted solely to pollution prevention. The mission of the Roundtable is to provide a national forum for promoting the development, implementation, and evaluation of efforts to avoid, eliminate, or reduce pollution at the source. NPPR publishes The Pollution Prevention Yellow Pages, a listing of regional P2 organizations that work with state and local governments, state and local government programs, federal agencies and EPA P2 coordinators, and non-profit groups, private sector organizations, and non-profit consultants who work on P2. The Roundtable's web site provides an abridged online version of The Pollution Prevention Yellow Pages information and links to state P2 programs, P2 resources, and a publications list. Home page: es.inel.gov/nppr.

Pacific Northwest Pollution Prevention Research Center. This Internet site offers a comprehensive database of pollution prevention research projects. Currently, the site includes fact sheets on more than 300 research projects. In addition, the site also includes analyses of successful pollution prevention approaches, which have been documented through demonstration projects. The site can help waste generators identify professionals with experience in areas of concern. Home page: pprc.pnl.gov/pprc.

P2 GEMS. This site, an Internet search tool operated by the Massachusetts Toxics Use Reduction Institute, can help facility planners, engineers and managers locate process and materials management information over the World Wide Web. It includes information on over 550 sites valuable for toxics use reduction planning and pollution prevention. Information is organized by categories including product/industry, chemical/waste, process, and management tools. Home page: turi.uml.edu/p2gems.

Pollution Prevention Information Clearinghouse (PPIC). PPIC maintains a collection of documents related to waste reduction. The clearinghouse serves as a distribution center for nonregulatory EPA documents. Some of the resources available include:

- Pollution Prevention Directory. U.S. EPA, Office of Pollution Prevention and Toxics, EPA742-B-94-005, September 1994.
- Pollution Prevention Information Clearinghouse Information Sheet. February 1994.
- Enviro\$en\$e (brochure). U.S. EPA, February 1996.
- Setting up a Pollution Prevention Program. EPA742-F-93-004, September 1993.
- ISO 14000: International Environmental Management Standards (EPA Standards Network

Appendix IV: Publications, Online Resources, and Software (cont.)

Fact Sheet). U.S. EPA, Office of Pollution Prevention and Toxics, EPA742-F-95-006, May 1995.

Contact PPIC at 202 260-1023 (e-mail: ppic@epamail.epa.gov) for a general information packet and a current list of materials available.

Technical Assistance Resources for Pollution Prevention (TARP2). This web site provides an extensive listing and links to Internet resources on pollution prevention topics. It includes descriptions of electronic resources for the federal government, state and local governments, research and information centers, international organizations, and business and industry links.
Home page: www.epa.ohio.gov/opp/tarp/tarp.html.

US Department of Energy (DOE) Industrial Assessment Centers (IACs). DOE's Office of Industrial Technologies sponsors free industrial assessments for small and medium-sized manufacturers. Teams of engineering students from the centers, located at 30 universities around the country, conduct energy audits or industrial assessments and provide recommendations to manufacturers to help them identify opportunities to improve productivity, reduce waste, and save energy. Recommendations from industrial assessments have averaged about \$55,000 in potential annual savings for each manufacturer. The IAC web site can help you locate the nearest IAC and learn more about the program.
Home page: www.oit.doe.gov/Access/iac.html.

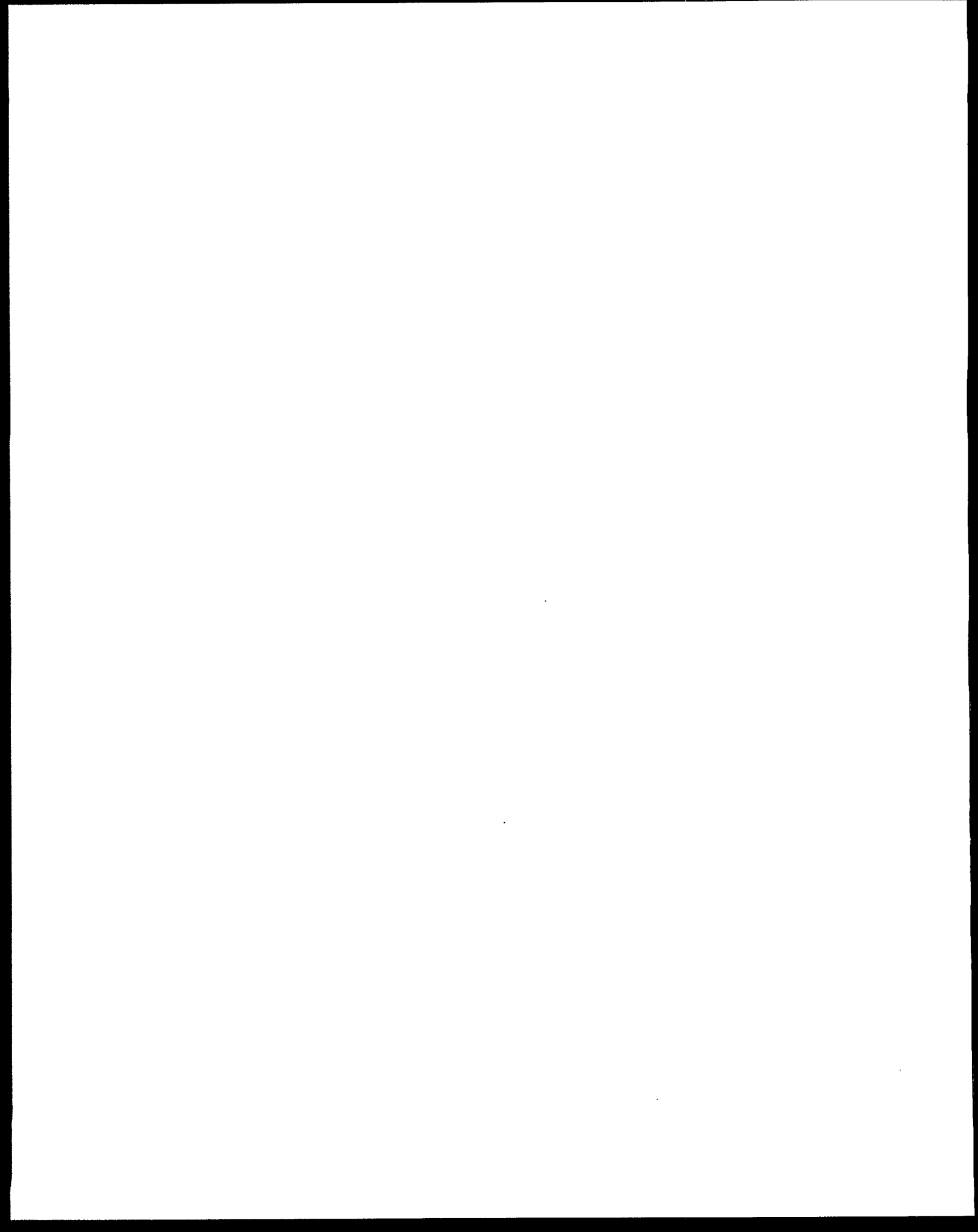
Western Region Pollution Prevention Network (P2 West). This is a network of on-line tools and off-line organizations in EPA Region 9 (Arizona, California, Hawaii, Nevada, Guam, and American Samoa). It lists pollution prevention assistance providers, vendors, consultants, partnering opportunities, useful documents, background information, ISO 14000 and environmental management information, and links to other sites.
Home page: www.westp2net.org.

Software

Governments and other organizations have developed software to help you assess your waste reduction options and implement solutions.

EPA software. Various EPA offices offer environmental software. For example, EPA Region 5 and Purdue University have developed the Software for Environmental Awareness (SEA) group of free programs, including PREVENT, a pollution prevention application. PREVENT provides an overview of P2 concepts and relevant environmental legislation and describes in detail P2 opportunities in the industry, agriculture, energy, government, and consumer sectors. It also features case studies and offers P2 information resources.
Home page: www.epa.gov/grtlakes/seahome.

Waste Reduction Advisory System (WRAS). Developed by the Hazardous Waste Research and Information Center (HWRIC), WRAS is an electronic waste management tool designed to assist waste generators reduce and recycle industrial waste. The tool includes a waste reduction checklist and a bibliography. The software costs \$95. To order, contact HWRIC at 217 333-8940.



CONSIDERING THE SITE
APPENDICES

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Appendix I: State Geological Surveys

For any changes to this information that may have occurred after publication of this document, consult the list kept by the University of Missouri-Rolla, on which this appendix is based, at <http://www.umsr.edu/~library/geol/geoloff.html>.

ALABAMA

Geological Survey of Alabama
P.O. Box O
420 Hackberry Lane
Tuscaloosa, AL 35486-9780

Phone: 205 349-2852

Fax: 205 349-2861

E-mail: gsa@ogb.gsa.tuscaloosa.al.us

Internet: <http://www.gsa.tuscaloosa.al.us>

ALASKA

Alaska Division of Geological & Geophysical Surveys
Suite 200
794 University Avenue
Fairbanks, AK 99709-3645

Phone: 907 451-5010

Fax: 907 451-5050

ARIZONA

Arizona Geological Survey
Suite 100
416 W. Congress St.
Tucson, AZ 85701

Phone: 520 770-3500

Fax: 520 770-3505

ARKANSAS

Arkansas Geological Commission
Vardelle Parham Geology Center
3815 West Roosevelt Rd.
Little Rock, AR 72204

Phone: 501 296-1877

Fax: 501 663-7360

CALIFORNIA

California Division of Mines and Geology
Department of Conservation
801 K Street, MS 12-30
Sacramento, CA 95814-3531

Phone: 916 445-1923

Fax: 916 445-5718

COLORADO

Colorado Geological Survey
Department of Natural Resources
1313 Sherman Street
Room 715
Denver, CO 80203

Phone: 303 866-2611

Fax: 303 866-2461

CONNECTICUT

Connecticut Geological & Natural History Survey
79 Elm St., Store Level
Hartford, CT 06106-5127

Phone: 860 424-3540

Fax: 860 424-4058

Appendix I: State Geological Surveys (cont.)

DELAWARE

Delaware Geological Survey
DGS Building
University of Delaware
Newark, DE 19716-7501

Phone: 302 831-2833
Fax: 302 831-3579

DISTRICT OF COLUMBIA

Geologist of Washington, D.C.
Department of Biology and Environmental
Science
MB 44-04
University of the District of Columbia
4200 Connecticut Avenue, N.W.
Washington, D.C. 20008-1154

Phone: 202 274-5886
Fax: 202 274-5589

FLORIDA

Florida Geological Survey
903 W. Tennessee St.
Tallahassee, FL 32304-7700

Phone: 904 488-4191
Fax: 904 488-8086

GEORGIA

Georgia Geological Survey
Department of Natural Resources
Room 400
19 Martin Luther King Jr. Drive, SW.
Atlanta, GA 30334

Phone: 404 656-3214
Fax: 404 657-8379

HAWAII

Hawaii Department of Land & Natural
Resources
Division of Water and Land Development
Box 373
Honolulu, HI 96809

Phone: 808 587-0230
Fax: 808 587-0283

IDAHO

Idaho Geological Survey
Morrill Hall, Room 332
University of Idaho
Moscow, ID 83843

Phone: 208 885-7991
Fax: 208 885-5826
e-mail: bennett@aspen.csr.uidaho.edu

ILLINOIS

Illinois State Geological Survey
Natural Resources Building
615 E. Peabody Drive
Champaign, IL 61820-6964

Phone: 217 333-4747
Fax: 217 244-7004
e-mail: isgs@geoserv.isgs.uiuc.edu
Internet: <http://www.isgs.uiuc.edu/isgshome.html>

INDIANA

Indiana Geological Survey
611 N. Walnut Grove
Bloomington, IN 47405

Phone: 812 855-9350
Fax: 812 855-2862
Internet: <http://www.indiana.edu/~igs/index.html>

Appendix I: State Geological Surveys (cont.)

IOWA

Iowa Department of Natural Resources
Geological Survey Bureau
109 Trowbridge Hall
Iowa City, IA 52242-1319
Phone: 319 335-1575
Fax: 319 335-2754
e-mail: dkoch@gsbth-po.igsb.uiowa.edu
Internet: <http://www.igsb.uiowa.edu>

KANSAS

Kansas Geological Survey
1930 Constant Avenue
West Campus
University of Kansas
Lawrence, KS 66047
Phone: 913 864-3965
Fax: 913 864-5317
Internet: <http://www.kgs.ukans.edu>

KENTUCKY

Kentucky Geological Survey
228 Mining & Mineral Resources Building
University of Kentucky
Lexington, KY 40506-0107
Phone: 606 257-5500
Fax: 606 257-1147

LOUISIANA

Louisiana Geological Survey
Box G
Louisiana State University
Baton Rouge, LA 70893
Phone: 504 388-5320
Fax: 504 388-5328

MAINE

Maine Geological Survey
Department of Conservation
22 State House Station
Augusta, ME 04333-0022
Phone: 207 287-2801
Fax: 207 287-2353

MARYLAND

Maryland Geological Survey
Maryland Department of Natural Resources
2300 St. Paul Street
Baltimore, MD 21218-5210
Phone: 410 554-5503
Fax: 410 554-5502
e-mail: ecleaves@mgs.dnr.md.gov
Internet: <http://mgs.dnr.md.gov>

MASSACHUSETTS

Massachusetts Office of Environmental
Affairs
100 Cambridge Street, 20th Floor
Boston, MA 02202
Phone: 617 727-5830, ext. 305
Fax: 617 727-2754

MICHIGAN

Michigan Geological Survey Division
State Geologist
P.O. Box 30256
Lansing, MI 48909-7756
Phone: 517 334-6923
Fax: 517 334-6038

Appendix I: State Geological Surveys (cont.)

MINNESOTA

Minnesota Geological Survey
University of Minnesota
2642 University Avenue
St. Paul, MN 55114-1057

Phone: 612 627-4780
Fax: 612 627-4778
e-mail: mgs@gold.tc.umn.edu
Internet: <http://www.geo.umn.edu:80/mgs/>

MISSISSIPPI

Mississippi Office of Geology
P.O. Box 20307
Jackson, MS 39289-1307

Phone: 601 961-5500
Fax: 601 961-5521

MISSOURI

Missouri Department of Natural Resources
Division of Geology & Land Survey
111 Fairgrounds Road
Rolla, MO 65402

Phone: 314 368-2100
Fax: 314 368-2111

MONTANA

Montana Bureau of Mines & Geology
Montana Tech of the University of Montana
1300 W. Park Street
Butte, MT 59701-8997

Phone: 406 496-4180
Fax: 406 496-4451

NEBRASKA

Nebraska Conservation & Survey Division
University of Nebraska-Lincoln
113 Nebraska Hall
Lincoln, NE 68588-0517

Phone: 402 472-3471
Fax: 402 472-2410
e-mail: pwigley@unlinfo.unl.edu

NEVADA

Nevada Bureau of Mines & Geology
University of Nevada, Stop 178
Reno, NV 89557

Phone: 702 784-6691
Fax: 702 784-1709

NEW HAMPSHIRE

New Hampshire Geological Survey
Department of Environmental Sciences
Box 2008
Concord, NH 03302-2008

Phone: 603 271-3406
Fax: 603 271-7894

NEW JERSEY

New Jersey Geological Survey
29 Arctic Parkway, CN-427
Trenton, NJ 08625-0427

Phone: 609 292-1185
Fax: 609 633-1004
Internet: <http://www.state.nj.us/dep/njgs/index.html>

Appendix I: State Geological Surveys (cont.)

NEW MEXICO

New Mexico Bureau of Mines & Mineral
Resources
Campus Station
Socorro, NM 87801
Phone: 505 835-5420
Fax: 505 835-6333
e-mail: bureau@gis.nmt.edu
Internet: <http://geoinfo.nmt.edu>

NEW YORK

New York State Geological Survey
New York State Museum
3140 Cultural Education Center
Empire State Plaza
Albany, NY 12230
Phone: 518 474-5816
Fax: 518 473-8496
e-mail: rfakundi@museum.nysed.gov

NORTH CAROLINA

North Carolina Geological Survey
Box 27687
Raleigh, NC 27611-7687
Phone: 919 733-3833
Fax: 919 733-4407

NORTH DAKOTA

North Dakota Geological Survey
600 East Boulevard
Bismark, ND 58505-0840
Phone: 701 328-9700
Fax: 701 328-9898

OHIO

Ohio Division of Geological Survey
Department of Natural Resources
4383 Fountain Square Drive
Columbus, OH 43224-1362
Phone: 614 265-6576
Fax: 614 447-1918

OKLAHOMA

Oklahoma Geological Survey
Energy Center, Room N-131
100 E. Boyd
Norman, OK 73019-0628
Phone: 405 325-3031
Fax: 405 325-7069
e-mail: cjmankin@uoknor.edu
Internet: <http://www.uoknor.edu/special/ogs-pttc>

OREGON

Oregon Department of Geology & Mineral
Industries
Suite 965
800 N.E. Oregon Street #28
Portland, OR 97232-2162
Phone: 503 731-4100
Fax: 503 731-4066
Internet: <http://sarvis.dogami.state.or.us>

PENNSYLVANIA

Pennsylvania Bureau of Topographic &
Geologic Survey
P.O. Box 8453
Harrisburg, PA 17105-8453
Phone: 717 787-2169
Fax: 717 783-7267

Appendix I: State Geological Surveys (cont.)

PUERTO RICO

Puerto Rico Geological Survey Division
Department of Natural & Environmental
Resources
Box 5887
Puerta de Tierra Station
San Juan, PR 00906

Phone: 809 722-2526

Fax: 809 724-0365

RHODE ISLAND

Rhode Island State Geologist
Department of Geology
University of Rhode Island
Kingston, RI 02881

Phone: 401 874-2265

Fax: 401 874-2190

e-mail: JACAIN@uriacc.uri.edu

Internet: <http://www.uri.edu/artsci/gel/rigeolst.htm>

SOUTH CAROLINA

South Carolina Geological Survey
5 Geology Road
Columbia, SC 29210-4089

Phone: 803 896-7708

Fax: 803 896-7695

SOUTH DAKOTA

South Dakota Geological Survey
University of South Dakota
414 East Clark Street
Vermillion, SD 57069-2390

Phone: 605 677-5227

Fax: 605 677-5895

TENNESSEE

Tennessee Division of Geology
L&C Tower, 13th Floor
401 Church Street
Nashville, TN 37243

Phone: 615 532-1500

TEXAS

Texas Bureau of Economic Geology
The University of Texas
Box X, University Station
Austin, TX 78713-8924

Phone: 512 471-1534

Fax: 512 471-0140

e-mail: tyler@begv.utexas.edu

Internet: <http://www.utexas.edu/depts/beg/>

UTAH

Utah Geological Survey
Box 146100
Salt Lake City, UT 84114-6100

Phone: 801 537-3300

Fax: 801 537-3400

e-mail: lallison@email.state.ut.us

Internet: <http://utstdpwww.state.ut.us/~ugs>

VERMONT

Vermont Geological Survey
Vermont Agency of Natural Resources
Center Building
103 S. Main Street
Waterbury, VT 05671-0301

Phone: 802 241-3499

Fax: 802 244-1102

e-mail: larryb@anrimsgis.anr.state.vt.us

Appendix I: State Geological Surveys (cont.)

VIRGINIA

Virginia Division of Mineral Resources
Box 3667
Charlottesville, VA 22903
Phone: 804 963-2308
Fax: 804 293-2239

WASHINGTON

Washington Department of Natural Resources
Division of Geology & Earth Resources
P.O. Box 47007
Olympia, WA 98504-7007
Phone: 360 902-1450
Fax: 360 902-1785
e-mail: cjmanson@u.washington.edu

WEST VIRGINIA

West Virginia Geological & Economic Survey
Mont Chateau Research Center
Box 879
Morgantown, WV 26507-0879
Phone: 304 594-2331
Fax: 304 594-2575
e-mail: info@geosrv.wvnet.edu

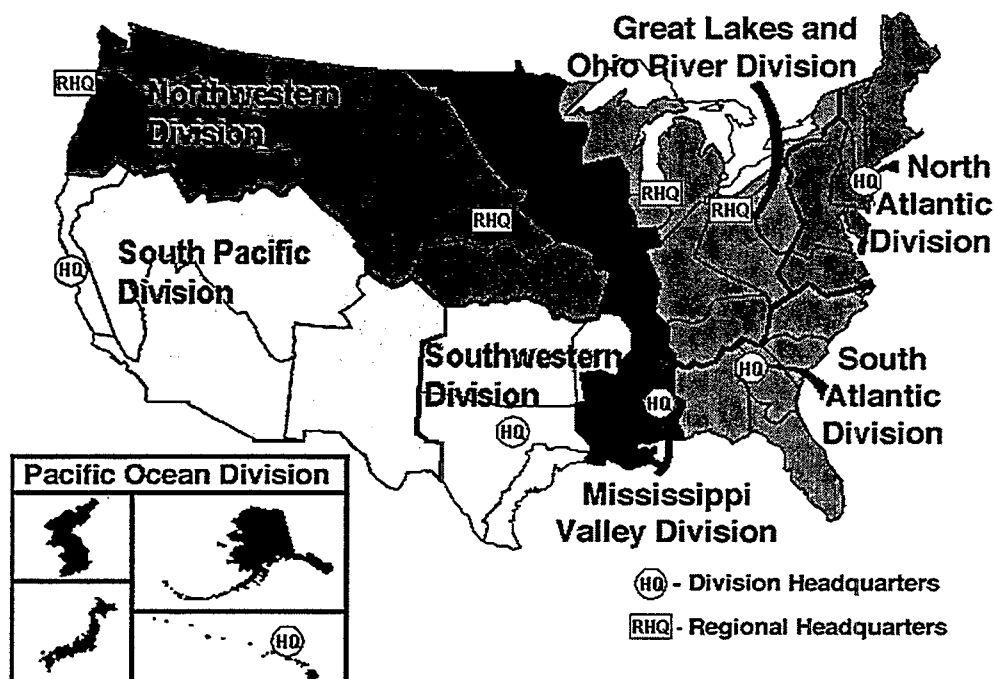
WISCONSIN

Wisconsin Geological & Natural History Survey
3817 Mineral Point Road
Madison, WI 53705-5100
Phone: 608 262-1705
Fax: 608 262-8086

WYOMING

Wyoming State Geological Survey
Box 3008
University Station
Laramie, WY 82071
Phone: 307 766-2286
Fax: 307 766-2605
e-mail: wsgs@wsgs.uwyo.edu
Internet: http://www_wwrc.uwyo.edu/wrds/wsgs/wsgs.html

Appendix II: U.S. Army Corps of Engineers District Contact Information



HQ, DIRECTORATE OF CIVIL WORKS

U.S. Army Corps of Engineers
Department of the Army
108 Army Pentagon
Washington, DC 20310-0108
Phone: 703 695-1370

LOWER MISSISSIPPI VALLEY DIVISION

U.S. Army Corps of Engineers
Lower MS Valley Division (CELMV-CO-R)
P.O. Box 80
Vicksburg, MS 39180-0080
Phone: 601 634-5821

Memphis District

U.S. Army Corps of Engineers
Memphis District (CELMM-CO-R)
B-202 Clifford Davis Federal Building
Memphis, TN 38103-1894
Phone: 901 544-3471

New Orleans District

U.S. Army Corps of Engineers
New Orleans District (CELMN-OD-R)
P.O. Box 60267
New Orleans, LA 70160-0267
Phone: 504 862-2255

St. Louis District

U.S. Army Corps of Engineers
St. Louis District (CELMS-OD-R)
1222 Spruce Street
St. Louis, MO 63103-2833
Phone: 314 331-8575

Vicksburg District

U.S. Army Corps of Engineers
Vicksburg District (CELMK-OD-F)
2101 North Frontage Road
Vicksburg, MS 39180-5191
Phone: 601 631-5376

Appendix II: U.S. Army Corps of Engineers District Contact Information (cont.)

MISSOURI RIVER DIVISION

U.S. Army Corps of Engineers
Missouri River Division (CEMRD-CO-O)
12565 West Center Road
Omaha, NE 68144
Phone: 402 697-2533

Kansas City District

U.S. Army Corps of Engineers
Kansas City District (CEMRK-OD-R)
700 Federal Building
Kansas City, MO 64106-2896
Phone: 816 426-3645

Omaha District

U.S. Army Corps of Engineers
Omaha District (CEMRO-OP-N)
215 North 17th Street
Omaha, NE 68102-4978
Phone: 402 221-4133

NEW ENGLAND DIVISION

U.S. Army Corps of Engineers
New England Division (CNED-OD-P)
424 Trapelo Road
Waltham, MA 02254-9149
Phone: 617 647-8057

NORTH ATLANTIC DIVISION

U.S. Army Corps of Engineers
North Atlantic Division (CENAD-CO-OP)
90 Church Street
New York, NY 10007-9998
Phone: 212 264-7535

Baltimore District

U.S. Army Corps of Engineers
Baltimore District (CENAB-OP-PN)
P.O. Box 1715
Baltimore, MD 31203-1715
Phone: 410 962-3670

New York District

U.S. Army Corps of Engineers
New York District (CENAN-PL-E)
26 Federal Plaza
New York, NY 10278-0090
Phone: 212 264-3996

Norfolk District

U.S. Army Corps of Engineers
Norfolk District (CENAO-OP-N)
803 Front Street
Phone: 804 441-7068

Philadelphia District

U.S. Army Corps of Engineers
Philadelphia District (CENAP-OP-N)
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390
Phone: 215 656-6725

NORTH CENTRAL DIVISION

U.S. Army Corps of Engineers
North Central Division (CENCD-CO-MO)
111 North Canal Street, 12th Floor
Chicago, IL 60606-7206
Phone: 312 353-7762

Appendix II: U.S. Army Corps of Engineers District Contact Information (cont.)

Buffalo District

U.S. Army Corps of Engineers
Buffalo District (CENCM-CO-R)
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 716 879-4313

Chicago District

U.S. Army Corps of Engineers
Chicago District (CENCC-CO)
111 North Canal Street, Sixth Floor
Chicago, IL 60606-7206
Phone: 312 886-3555

Detroit District

U.S. Army Corps of Engineers
Detroit District (CENCE-CO-OR)
P.O. Box 1027
Detroit, MI 48231-1027
Phone: 313 226-2432

Rock Island District

U.S. Army Corps of Engineers
Rock Island District (CENCR-OD-R)
P.O. Box 2004
Clock Tower Building
Rock Island, IL 61204-2004
Phone: 309 794-5370

St. Paul District

U.S. Army Corps of Engineers
St. Paul District (CENCS-SO-PO)
1421 USPO & Custom House
190 Fifth Street East
St. Paul, MN 55101-1638
Phone: 612 290-5376

NORTH PACIFIC DIVISION

U.S. Army Corps of Engineers
North Pacific Division (CENPD-CO-R)
P.O. Box 2870
Portland, OR 97208-2870
Phone: 503 326-3780

Alaska District

U.S. Army Corps of Engineers
Alaska District (CENPA-CO-NF)
P.O. Box 898
Anchorage, AK 99506-0898
Phone: 907 753-2712

Portland District

U.S. Army Corps of Engineers
Portland District (CENPP-OP-PN)
P.O. Box 2946
Portland, OR 97208-2946
Phone: 503 326-7146

Seattle District

U.S. Army Corps of Engineers
Seattle District (CENPS-OP-PO)
P.O. Box 3755
Seattle, WA 98124-2255
Phone: 206 764-6695

Walla Walla District

U.S. Army Corps of Engineers
Walla Walla District (CENPW-OP-RM)
City-County Airport
Walla Walla, WA 99362-9265
Phone: 509 522-6720

Appendix II: U.S. Army Corps of Engineers District Contact Information (cont.)

OHIO RIVER DIVISION

U.S. Army Corps of Engineers
Ohio River Division (CEORD-DO-OR)
P.O. Box 1159
Cincinnati, OH 45201-1159
Phone: 513 529-5487

Huntington District

U.S. Army Corps of Engineers
Huntington District (CEORH-OR-F)
502 Eighth Street
Huntington, WV 25701-2070
Phone: 304 529-5487

Louisville District

U.S. Army Corps of Engineers
Louisville District (CEORH-OR-F)
P.O. Box 59
Louisville, KY 40201-0059
Phone: 502 582-6461

Nashville District

U.S. Army Corps of Engineers
Nashville District (CEORN-OR-R)
P.O. Box 1070
Nashville, TN 37202-1070
Phone: 615 736-5181

Pittsburgh District

U.S. Army Corps of Engineers
Pittsburgh District (CEORP-OR-R)
1000 Liberty Avenue
Pittsburgh, PA 15222-4186
Phone: 412 644-6872

PACIFIC OCEAN DIVISION

U.S. Army Corps of Engineers
Pacific Ocean Division (CEPOD-CO-O)
Building 230
Fort Shafter, HI 96858-5440
Phone: 808 438-9258

SOUTH ATLANTIC DIVISION

U.S. Army Corps of Engineers
South Atlantic Division (CESAD-CO-R)
77 Forsythe Street, SW., Room 313
Atlanta, GA 30335-6801
Phone: 404 331-2778

Charleston District

U.S. Army Corps of Engineers
Charleston District (CESAC-CO-M)
P.O. Box 919
Charleston, SC 29402-0919
Phone: 803 727-4604

Jacksonville District

U.S. Army Corps of Engineers
Jacksonville District (CESAJ-CO-OR)
P.O. Box 4970
400 West Bay Street
Jacksonville, FL 32232-0019
Phone: 904 232-2907

Mobile District

U.S. Army Corps of Engineers
Mobile District (CESAM-OP-R)
109 St. Joseph Street
P.O. Box 2288
Mobile, AL 36628-0001
Phone: 205 690-2658

Appendix II: U.S. Army Corps of Engineers District Contact Information (cont.)

Savannah District

U.S. Army Corps of Engineers
Savannah District (CESAS-OP-R)
P.O. Box 889
Savannah, GA 31402-0889
Phone: 912 652-5347

Wilmington District

U.S. Army Corps of Engineers
Wilmington District (CESAW-CO-R)
P.O. Box 1890
Wilmington, NC 28402-1890
Phone: 919 251-4630

SOUTH PACIFIC DIVISION

U.S. Army Corps of Engineers
South Pacific Division (CESPD-CO-O)
630 Sansome Street, Room 1216
San Francisco, CA 94111-2206
Phone: 215 705-1443

Los Angeles District

U.S. Army Corps of Engineers
Los Angeles District (CESPL-CO-R)
P.O. Box 2711
Los Angeles, CA 90053-2325
Phone: 213 894-5606

Sacramento District

U.S. Army Corps of Engineers
Sacramento District (CESPK-CO-R)
1325 J Street
Sacramento, CA 95814-2922
Phone: 916 894-5606

SOUTHWESTERN DIVISION

U.S. Army Corps of Engineers
Southwestern Division (CESWD-CO-R)
1114 Commerce Street
Dallas, TX 75242-0216
Phone: 214 767-2436

Albuquerque District

U.S. Army Corps of Engineers
Albuquerque District (CESWA-CO-R)
4101 Jefferson Plaza NE.
Albuquerque, NM 87109-3435
Phone: 505 342-3282

Fort Worth District

U.S. Army Corps of Engineers
Fort Worth District (CESWF-OD-M)
P.O. Box 17300
Fort Worth, TX 76102-0300
Phone: 817 334-2681

Galveston District

U.S. Army Corps of Engineers
Galveston District (CESWG-CO-MO)
P.O. Box 1229
Galveston, TX 77553-1229
Phone: 409 766-3930

Little Rock District

U.S. Army Corps of Engineers
Little Rock District (CESWL-CO-L)
P.O. Box 867
Little Rock, AR 72203-0867
Phone: 501 324-5296

Appendix II: U.S. Army Corps of Engineers District Contact Information (cont.)

Tulsa District

U.S. Army Corps of Engineers
Tulsa District (CESWT-OD-R)
P.O. Box 61
Tulsa, OK 74121-0061
Phone: 918 669-7400

WATERWAYS EXPERIMENT STATION

Wetlands Research Program
U.S. Army Corps of Engineers
Waterways Experiment Station
Environmental Lab (CESWES-EL-W)
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
Phone: 601 634-2733

Appendix III: State Wellhead Protection Contact Information

REGION I

Connecticut Wellhead Protection

Fred Banach
Connecticut Department of Environmental
Protection
Water Management Bureau
79 Elm Street
Hartford, CT 06106-5127
Phone: 860 424-3020

Massachusetts Wellhead Protection

Tara Gallagher
Massachusetts Department of
Environmental Protection
Drinking Water Program
One Winter Street
Boston, MA 02108
Phone: 617 292-5930
e-mail: tgallagher@state.ma.us

Maine Wellhead Protection

David Braley
Maine Department of Human Services
10 State House Station
Augusta, ME 04333
Phone: 207 287-3194
Fax: 207 287-4172

New Hampshire Wellhead Protection

Sarah Pillsbury
New Hampshire Department of
Environmental Services
Water Supply Engineering Bureau
6 Hazen Drive, POB 95
Concord, NH 03302
Phone: 603 271-1168
Fax: 603 271-2181
e-mail: pillsbury@deswspws.mv.com

Rhode Island Wellhead Protection

Ernie Panciera
Office of Drinking Water Quality
Rhode Island Department of Environment
235 Promenade Street
Providence, RI 02908
Phone: 401 227-2234, ext. 7603

Vermont Wellhead Protection

David Butterfield
Vermont Department of Environmental
Conservation
Water Supply Division
103 South Main Street
The Old Pantry
Waterbury, VT 05671-0403
Phone: 802 241-3400
Fax: 802 241-3284

REGION II

New Jersey Wellhead Protection

Daniel Van Abs
Office of Land and Water Planning
New Jersey Department of Environmental
Protection
401 E. State Street
Trenton, NJ 08625
Phone: 609 633-1179
Fax: 609 292-0687

New York Wellhead Protection

Warren Lavery
New York State Department of
Environmental Conservation
50 Wolf Road, Room 302
Albany, NY 12233-3504
Phone: 518 457-0791
Fax: 518 485-7786

Appendix III: State Wellhead Protection Contact Information (cont.)

Puerto Rico Wellhead Protection

Eric Morales
Water Quality Area
Puerto Rico Environmental Quality Board
P. O. Box 11488
Santurce, PR 00910
Phone: 787 751-5548
Fax: 787 767-1962

US Virgin Islands Wellhead Protection

Austin Moorehead
Virgin Islands Department of
Environmental Protection
Water Gut Homes 1118
Christiansted, St. Croix 00820-5065
Phone: 340 773-0565

REGION III

Delaware Wellhead Protection

John T. Barndt
Water Supply Section
Division of Water Resources
Delaware Department of Natural Resources
and Environmental Control
P.O. Box 1401
Dover, DE 19903
Phone: 302 739-4793
Fax: 302 739-2296
e-mail: jbarndt@dnrec.state.de.us

Maryland Wellhead Protection

John Grace
Water Supply Program
Water Management Administration
2500 Broening Highway
Baltimore, MD 21224
Phone: 410 631-3714

Pennsylvania (No approved WHP)

Joseph Lee
Division of Water Supplies, 11th Floor
Pennsylvania Department of Environmental
Resources
400 Market Street, Box 8467
Harrisburg, PA 17105-8467
Phone: 717 772-4018
e-mail: lee.joseph@al.dep.state.pa.us

Virginia Wellhead Protection

Terry Wagner
Ground Water Program
Virginia Department of Environmental
Quality
P. O. Box 11143
Richmond, VA 23230
Phone: 804 698-4043
e-mail: tdwagner@deq.state.va.us

West Virginia Wellhead Protection

Bill Toomey
West Virginia Department of Health
Environmental Engineering Division
815 Quarrier Street, Suite 418
Charleston, WV 25301
Phone: 304 558-2981
Fax: 304 558-0691
email: wtoomey@wvdhhr.org

REGION IV

Alabama Wellhead Protection

Sonja Massey
Ground Water Branch
Department of Environmental Management
1751 Congressman W. L. Dickinson Drive
P. O. Box 301463
Montgomery, AL 36130-1463
Phone: 334 271-7832
Fax: 334 271-7950

Appendix III: State Wellhead Protection Contact Information (cont.)

Florida (No approved WHP)

Jim McNeal
Bureau of Water Resources Protection
Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Phone: 904 488-3601
Fax: 904 487-3618

Georgia Wellhead Protection

Sandra Robertson
Georgia Geologic Survey, Room 400
19 Martin Luther King, Jr. Drive, SW
Atlanta, GA 30334

Phone: 404 656-3214
Fax: 404 657-8379

Kentucky Wellhead Protection

David Leo
Division of Water
Department of Environmental Protection
14 Reilly Road, Fort Boone Plaza
Frankfort, KY 40601

Phone: 502 564-5410
Fax: 502 564-4245

Mississippi Wellhead Protection

Jamie Crawford
Ground Water Planning Branch
P. O. Box 10385
Jackson, MS 39289-0385

Phone: 601 961-5354
Fax: 601 354-6612

North Carolina Wellhead Protection

Carl Bailey
Ground Water Section
Department of Environmental Health and
Natural Resources
P. O. Box 29535
Raleigh, NC 27626

Phone: 919 733-3221
Fax: 919 715-0588

South Carolina Wellhead Protection

Jim Hess
Ground Water Protection Division
Department of Health and Environmental
Control
2600 Bull Street
Columbia, SC 29201

Phone: 803 734-5465
Fax: 803 734-4661

Tennessee Wellhead Protection

Tom Moss
Ground Water Management Section
Division of Water Supply
Department of Environment and
Conservation
401 Church Street
Nashville, TN 37243-1549

Phone: 615 532-0170
e-mail: tmoss@mail.state.tn.us

Appendix III: State Wellhead Protection Contact Information (cont.)

REGION V

Illinois Wellhead Protection

Rick Cobb
Division of Public Water Supplies
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, IL 62794-9276
Phone: 217 785-4787
Fax: 217 782-0075
e-mail: epa3188@epa.il.us

Indiana Wellhead Protection

Rob Duncan
Ground Water Section
Indiana Department of Environmental
Management
P.O. Box 6015
Indianapolis, IN 46206-6015
Phone: 317 308-3322
Fax: 317 308-3339

Michigan Wellhead Protection

Steve Miller
Office of Water Resources
Michigan Department of Natural Resources
P. O. Box 30028
Lansing, MI 48909
Phone: 517 373-8804
Fax: 517 335-4053

Minnesota Wellhead Protection

Bruce Olsen
Drinking Water Protection Section
Minnesota Department of Health
P.O. Box 64975
St. Paul, MN 55164-0975
Phone: 612 215-0796
Fax: 612 215-0979
e-mail: bruce.olsen@health.state.mn.us

Ohio Wellhead Protection

Mike Baker
Division of Drinking and Ground Waters
Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, OH 43216-1049
Phone: 614 644-2752
Fax: 614 644-2909
e-mail: mike-baker@central.epa.ohio.gov

Wisconsin Wellhead Protection

David Lindorff
Wisconsin Department of Natural
Resources
Bureau of Drinking Water and
Groundwater
P.O. Box 7921
Madison, WI 53707-7921
Phone: 608 266-9265
Fax: 608 267-7650
email: lindod@dnr.state.wi.us

REGION VI

Arkansas Wellhead Protection

Bob Makin
Division of Engineering
Arkansas Department of Health
4815 West Markham
Little Rock, AR 72205-3867
Phone: 501 661-2136
Fax: 501 661-2032

Louisiana Wellhead Protection

Keith L. Casanova
Ground Water Protection Division
Louisiana Department of Environmental
Quality
P. O. Box 82215
Baton Rouge, LA 708 84-2215
Phone: 504 765-0585
Fax: 504 765-0602
e-mail: keithc@deq.state.la.us

Appendix III: State Wellhead Protection Contact Information (cont.)

New Mexico Wellhead Protection

Darren Padilla
Drinking Water Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87501
Phone: 505 827-7536
e-mail: darren_padilla@nmenv.state.nm.us

Oklahoma Wellhead Protection

Mike Houts
Water Quality Division
Oklahoma Department of Environmental
Quality
1000 NE 10th Street
Oklahoma City, OK 73117-1212
Phone: 405 271-7899
e-mail:
michael.houts@OKLAOSF.state.ok.us

Texas Wellhead Protection

Brad Cross
Public Drinking Water Section (MC-155)
Texas Natural Resource Conservation
Commission
P.O. Box 13087
Austin TX, 78711-3087
Phone: 512 239-6020
Fax: 512 239-6050
e-mail: bcross@tnrcc.state.tx.us

REGION VII

Iowa Wellhead Protection

Darrell McAllister
Iowa Department of Natural Resources
Henery A. Wallace Building
900 E. Grand
Des Moines, Iowa 50319
Phone: 515 281-8869
Fax: 515 281-8895

Kansas Wellhead Protection

Karl Muedener
Kansas Department of Health and
Environment
Forbes Field, Building 283
Topeka, KS 66620-0001
Phone: 913 296-5500
Fax: 913 296-5509

Missouri Wellhead Protection

John Madras
Missouri Department of Natural Resources
P. O. Box 176
Jefferson City, MO 65102
Phone: 314 751-7428
Fax: 314 751-9396

Nebraska Wellhead Protection

Dennis Heitmann
Nebraska Department of Environmental
Quality
P. O. Box 98922
Lincoln, NE 68509-8922
Phone: 402 471-0096
Fax: 402 471-2909

REGION VII

Colorado Wellhead Protection

Kathleen Reilly
Colorado Department of Health &
Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Phone: 303 692-3573
Fax: 303 782-0390
e-mail: kathleen.reilly@state.co.us

Appendix III: State Wellhead Protection Contact Information (cont.)

Montana Wellhead Protection

John Arrigo
Montana Department of Health and
Environmental Sciences
Cogswell Building
Helena, MT 59620
Phone: 406 444-5327
Fax: 406 444-5492

North Dakota Wellhead Protection

James Horner
North Dakota Department of Health
P. O. Box 5520
Bismarck, ND 58502-5520
Phone: 701 328-5216
Fax: 701 328-5200

South Dakota Wellhead Protection

Jeanne Goodman
South Dakota Department of
Environmental and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181
Phone: 605 773-3296
Fax: 605 773-6035
e-mail: jeanneg@denr.state.sd.us

Utah Wellhead Protection

Sumner Newman
Utah Department of Environmental Quality
Division of Drinking Water
P.O. Box 144830
150 North 1950 West
Salt Lake City, UT 84114-4830
Phone: 801 536-4195
Fax: 801 536-4211
e-mail: snewanman@deq.state.ut.us

Wyoming Wellhead Protection

Kevin Frederick
Wyoming Department of Environmental
Quality
Water Quality Division
Herschler Building
122 West 25th Street
Cheyenne, WY 82002
Phone: 307 777-5985
Fax: 307 777-5973
e-mail: kfrede@missc.state.wy.us

REGION IX

Arizona Wellhead Protection

Moncef Tihami
Arizona Department of Environmental
Quality
Water Quality Division
3033 North Central Avenue
Phoenix, AZ 85012
Phone: 602 207-4425
Fax: 602 207-4634
email: tihami.moncef@ev.state.az.us

California (No approved WHP)

Carl Hauge
Department of Water Resources
1020 9th Street
Sacramento, CA 95814
Phone: 916 327-8861
Fax: 916 327-1648

Hawaii Wellhead Protection

June Harrigan
Department of Health
Environmental Planning Office
919 Ala Moana Boulevard
Honolulu, HI 96814
Phone: 808 586-4337
Fax: 808 586-4370

Appendix III: State Wellhead Protection Contact Information (cont.)

Nevada Wellhead Protection

Lucia Machado
Nevada Division of Environmental
Protection
333 West Nye Lane
Carson City, NV 89710
Phone: 702 687-4670 Ext. 3092
Fax: 702 687-6396

Northern Mariana Islands Wellhead Protection

Tony Guerrero
Commonwealth of Northern Mariana
Islands
Division of Environmental Quality
Drinking Water Program
P.O. Box 1304-CK
Saipan, MP 96950
Phone: 011 670 234-1012
Fax: 011 670 234-1003

REGION X

Alaska (No approved WHP program)

James Weise
Drinking Water Program
Alaska Department of Environmental
Conservation
555 Cordova Street
Anchorage, AK 99501
Phone: 507 269-7685
e-mail: jweise@envircon.state.ak.us

Idaho Wellhead Protection

Dean Yashan
Idaho Department of Health & Welfare
Division of Environmental Quality
1410 North Hilton Street
Boise, ID 83706
Phone: 208 373-0260

Fax: 208 373-0576

Oregon Wellhead Protection

Sheree Stewart
Drinking Water Protection Program
Oregon Department of Environmental
Quality
811 SW 6th Avenue
Portland, OR 97204-1390
Phone: 503 229-5413
Fax: 503 229-6037
e-mail: sheree.stewart@state.or.us

Washington Wellhead Protection

David Jennings
Department of Health
Division of Drinking Water
P.O. Box 47822
Olympia, WA 98504-7822
Phone: 360 586-9041
Fax: 360 586-5529
e-mail: dgj0303@hub.doh.wa.gov

Appendix IV: State Buffer Zone Considerations

The universe of industrial nonhazardous solid wastes and unit types is broad and diverse. States have established various approaches to address location considerations of the variety of wastes and units in their states. The tables below summarize the range of buffer zone restrictions and most common buffer zone values specified for each unit type by some states to address their local concerns. The numbers in the tables are not meant to advocate the adoption of a buffer zone of any particular distance; rather, they

serve only as examples of restrictions states have individually developed.

- **Surface Impoundments.** Restrictions with respect to buffer zones vary among states. In addition, states allow exemptions or variances to these buffer zone restrictions on a case-by-case basis. Table 1 presents the range of values and the most common value used by states for each buffer zone category.

Table 1
State Buffer Zone Restrictions for Surface Impoundments

Buffer Zone Category	Range of Values - minimum distance (number of states with restrictions)		Most Common Value (number of states with restrictions)	
Groundwater Table	1 to 15 feet	(4)	5 feet	(2)
Property Boundaries	100 to 200 feet	(4)	100 feet	(2)
Drinking Water Wells	1,200 to 1,320 feet	(2)	1,200 feet (1) 1,320 feet (1)	
Public Water Supply	500 to 1,320 feet	(4)	1,320 feet	(1)
Surface Water Body	100 to 1,320 feet	(4)	100 feet	(2)
Houses or Buildings	300 to 1,320 feet	(4)	1,320 feet	(2)
Roads	1,000 feet	(1)	1,000 feet	(1)

Appendix IV: State Buffer Zone Considerations (cont.)

- **Landfills.** Table 2 presents the range of values and the most common state buffer zone restrictions for landfills.

Table 2
State Buffer Zone Restrictions for Landfills

Buffer Zone Category	Range of Values - minimum distance (number of states with restrictions)	Most Common Value (number of states with restrictions)
Groundwater Table	1 to 15 feet (12)	5 feet (4)
Property Boundaries	20 to 600 feet (14)	100 feet (7)
Drinking Water Wells	500 to 1,320 feet (9)	500 feet (2) 600 feet (2) 1,200 feet (2)
Public Water Supply	400 to 5,280 feet (13)	1,200 feet (3)
Surface Water Body	100 to 2,000 feet (20)	100 feet (5) 1,000 feet (5)
Houses or Buildings	200 to 1,320 feet (14)	500 feet (7)
Roads	50 to 1,000 feet (8)	1,000 feet (5)
Park Land	1,000 to 5,280 feet (7)	1,000 feet (4)
Fault Areas	200 feet (2)	200 feet (2)

- **Waste Piles.** Table 3 presents the state buffer zone restrictions for wastepiles. Of the four states with buffer zone restrictions, only two states specified minimum distances.

Table 3
State Buffer Zone Restrictions for Waste Piles

Buffer Zone Category	Range of Values - minimum distance (number of states with restrictions)	Most Common Value (number of states with restrictions)
Groundwater Table	4 feet* (1)	4 feet (1)
Property Boundaries	50 feet (1)	50 feet (1)
Surface Water Body	50 feet (1)	50 feet (1)
Houses or Buildings or Recreational Area	200 feet (1)	200 feet (1)
Historic Archeological Site or Critical Habitat	Minimum distance not specified (1)	Minimum distance not specified (1)

*If no liner or storage pad is used, then this state requires four feet between the waste and the seasonal high water table.

Appendix IV: State Buffer Zone Considerations (cont.)

- **Land Application.**¹ Table 4 presents the range of values and the most common state buffer zone restrictions for land application.

Table 4
State Buffer Zone Restrictions for Land Application

Buffer Zone Category	Range of Values - minimum distance (number of states with restrictions)	Most Common Value (number of states with restrictions)
Groundwater Table	4 to 5 feet (3)	4 feet (1) 5 feet (1)
Property Boundaries	50 to 200 feet (4)	50 feet (2)
Drinking Water Wells	200 to 500 feet (2)	200 feet (1)
Public Water Supply	300 to 5,280 feet (3)	300 feet (1) 1,000 feet (1) 5,280 feet (1)
Surface Water Body	100 to 1,000 feet (5)	100 feet (2)
Houses or Buildings	200 to 3,000 feet (6)	300 feet (2)
Park Land	2,640 feet (1)	2,640 feet (1)
Fault Areas	200 feet (1)	200 feet (1)
Max. Depth of Treatment	5 feet (1)	5 feet (1)
Pipelines	25 feet (1)	25 feet (1)
Critical Habitat	No minimum distance set (2)	No minimum distance set (2)
Soil Conditions	Not on frozen, ice or snow covered, or water saturated soils (1)	Not on frozen, ice or snow covered, or water saturated soils (2)

¹In the review of state regulations performed to develop Table 4, it was not possible to distinguish between units used for treatment and units where wastes are added as a soil amendment. We recommend that you consult applicable state agencies to determine which buffer zone restrictions are relevant to your land application unit.

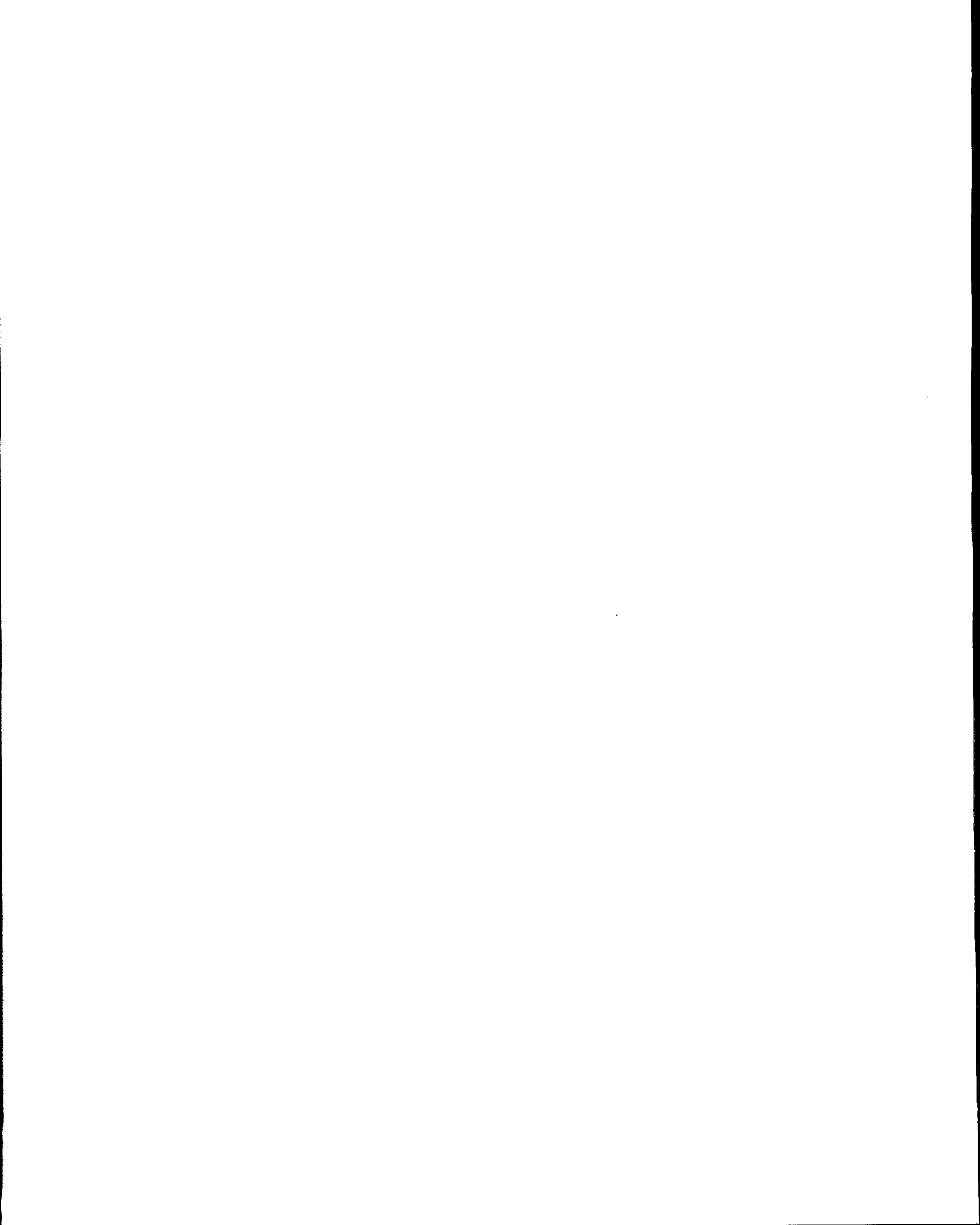
Appendix IV: State Buffer Zone Considerations (cont.)

Based on the review of state requirements, Table 5 presents the most common buffer zones restrictions across all four unit types.

Table 5
Common Buffer Zone Restrictions Across All Four Unit Types

Buffer Zone Category (total number of states for all unit types)		Most Common Values (number of states with restrictions)	
Groundwater Table	(20)	4 feet	(4)
		5 feet	(4)
Property Boundaries	(23)	50 feet	(8)
		100 feet	(5)
Drinking Water Wells	(13)	500 feet	(3)
Public Water Supply	(20)	1,000 feet	(3)
		1,200 feet	(3)
Surface Water Body	(30)	100 feet	(5)
		200 feet	(5)
		1,000 feet	(5)
Houses or Buildings	(25)	500 feet	(9)

PROTECTING AIR QUALITY
APPENDICES



Appendix I: General Information About the Clean Air Act

Internet and Other Computer Resources

OAR World Wide Web Site - <www.epa.gov/oar/oarhome.html>

EPA's Office of Air and Radiation (OAR) is responsible for many programs designed to reduce air pollution and improve public health nationwide. OAR's web site provides a wide range of information, including fact sheets, brochures, and other documents on such topics as ozone depletion, acid rain, radon, urban air quality, global warming, pollution from mobile sources, and much more. Links are provided to each program office and to a search function. Visitors can read numerous fact sheets, regulations, and other documents online, print them directly from the site, or download them for later use. Information about the structure of the Office and key contacts is also available. Please note that the world wide address is all lower case.

Airlinks Web Page - <www.epa.gov/airlinks>

The Airlinks page provides an excellent overview of air pollution topics in the news. Information and links are updated frequently as air pollution "hot topics" change from month to month. Airlinks also provides links to other major OAR web sites and information resources.

Technology Transfer Network (TTN) <www.epa.gov/ttn>

The TTN is a web site that contains general information on Clean Air Act issues and programs, regulations, guidance documents, and fact sheets that can be accessed electronically by the public.

Written Materials

The Plain English Guide to the Clean Air Act (1993)

Explains in non-technical, straightforward language the provisions of the Clean Air Act of 1990. EPA400-K-93-001. Available from the National Center for Environmental Publications (NCEPI) 800 490-9198, and online at <www.epa.gov/epahome/publications.htm>.

What You Can Do to Reduce Air Pollution (1992)

A citizen's guide to what individuals can do to help meet the goals of the Clean Air Act of 1990. Also outlines the causes and effects of air pollution. EPA450-K-92-002. Available from NCEPI 800 490-9198, and online at <www.epa.gov/epahome/publications.htm>.

The Clean Air Act of 1990: A Primer on Consensus-Building (1992)

Outlines collaborative decision-making processes to assist agencies, organizations, and individuals embarking on consensus-building activities in the implementation of the Clean Air Act. EPA450-K-92-004. Available from NCEPI 800 490-9198, and online at <www.epa.gov/epahome/publications.htm>.

Clean Air Act Amendments of 1990: Detailed Summary of Titles (1990)

A highly detailed and relatively technical treatment of Titles I through IX of the Clean Air Act. EPA400-R-90-100. Available from NCEPI 800 490-9198, and online at <www.epa.gov/epahome/publications.htm>.

Appendix I: General Information About the Clean Air Act (cont.)

The Clean Air Act Amendments of 1990: Overview and of Summary Materials (1990)

Contains an overview of the Clean Air Act of 1990, one page summaries of the key titles, a glossary of terms, and a legislative chronology. This document serves as useful background on the Clean Air Act. EPA450-K-90-100. Available from NCEPI 800 490-9198, and online at www.epa.gov/epahome/publications.htm.

Implementation Strategy for the Clean Air Act of 1990: Update July, 1997

Summarizes plans to implement the Clean Air Act of 1990 within the time frames set by Congress. Multi-year document. EPA410-K-97-001. Available from NCEPI 800 490-9198, and online at www.epa.gov/epahome/publications.htm.

EPA Journal, The New Clean Air Act: What it Means to You (1991)

This entire edition of the Journal is devoted to discussions of various issues related to the Clean Air Act. Volume 17, No.1, January/February 1991. EPA21K-1004. Available from NCEPI 800 490-9198, and online at www.epa.gov/epahome/publications.htm.

The Clean Air Act Amendments of 1990: A Guide for Small Businesses (1992)

Explains how the various parts of the Clean Air Act can affect small businesses and how small businesses can obtain information and assistance. EPA450-K-92-001. Available from NCEPI 800 490-9198, and online at www.epa.gov/epahome/publications.htm.

Videotapes

OZONE: Double Trouble (1993)

This 18-minute video describes for the layperson the differences between stratospheric ozone and ground-level ozone (smog), how ground-level and stratospheric ozone can affect public health and the environment, and what people can do to improve air quality. OZONE: Double Trouble answers these questions in a dynamic style, with simple language, and effective visuals. Contact Dennis Shipman, 919 541-5477.

Accessing EPA Information (1996)

This telecourse provides an overview and guided tour of the various means of electronic access to EPA and other public sector sources of environmental information. Widely available and practical tools and techniques including modem connections to the Internet are described. Limited quantities available for loan. Contact Dennis Shipman, 919 541-5477.

Clean Air Act Update

During this annual telecourse, EPA representatives discuss issues and programs underway in implementing the Clean Air Act Amendments of 1990. Features include Title I nonattainment provisions, status of implementation of the Title V operating permits program, the Title III air toxics provision, and other Clean Air Act issues. Limited quantities available for loan. Contact Dennis Shipman, 919 541-5477.

Appendix I: General Information About the Clean Air Act (cont.)

ACID RAIN PROGRAM

Internet Resources and Telephone Hotlines

Acid Rain Program World Wide Web Site - <www.epa.gov/acidrain/ardhome.html>

Features fact sheets, press releases, program reports, the latest information on emissions and the allowance market, guidance documents, and regulations. Student resources also available.

Acid Rain Hotline - 202 233-9620

This voicemail system provides fact sheets and other information about acid rain and its effects via fax and mail. Callers may also leave technical and policy questions and a staff member will respond within 24 hours.

Written Materials

Acid Rain Program Brochures

The Acid Rain Program offers two brochures titled *The Acid Rain Program - It's Working* (EPA430-F-92-027) and *Environmental Benefits of Reducing Acid Rain* (EPA430-F-92-026). These brochures describe the causes and effects of acid rain, how EPA is reducing acid rain, and the benefits of this reduction. Available from NCEPI 800 490-9198, and online at <www.epa.gov/epahome/publications.htm>.

Acid Rain Fact Sheets

Fact sheets are available on all aspects of the program, including:

- Program Overview
- Environmental Benefits of Acid Rain Reduction
- Allowance System
- Allowance Auctions and Sales
- Allowance Allocations
- Permits
- Continuous Emissions Monitoring
- Excess Emissions
- Opt-in Program
- Annual Data Reconciliation
- NOx Program

Available from the Acid Rain Hotline, 202 233-9620.

US/Canada Air Quality Progress Report (1996)

Published jointly with the government of Canada, this interim report discusses the effects of acid rain in both countries. The report also contains general information on the US-Canada Air Quality Agreement. Available from the Acid Rain Hotline, 202 233-9620.

Appendix I: General Information About the Clean Air Act (cont.)

Acid Rain, A Student's First Sourcebook (1994)

Simple and concise educational text that explores the effects of acid rain on human health, forests, water quality, and buildings. The sourcebook also provides experiments and activities that demonstrate the effects of acid rain. EPA600-9-90-027A. Available from NCEPI 800 490-9198, and online at www.epa.gov/epahome/publications.htm.

Acid Rain Program Update

Periodic publication with information on new developments related to acid rain, including ongoing reports on program progress and results. Available from the Acid Rain Hotline, 202 233-9620.

Emissions Scorecard

Annual publication detailing trends in heat input and emissions of sulfur dioxide (SO₂), 2 nitrous oxides (NO_x), and carbon dioxide (CO₂) in the electric utility industry. Includes 2 state-wide and national totals in each category. Available from the Acid Rain Hotline, 202 233-9620.

Compliance Results (1995)

A summary of the first year of compliance with the Acid Rain Program. Shows the emissions reductions of affected utility units, environmental gains, monitoring performance, and program efficiency. Contains details of the 1995 annual data reconciliation. Available from the Acid Rain Hotline, 202 233-9620.

Human Health Benefits from Sulfate Reductions Under Title IV of the 1990 Clean Air Act

The result of a two-year study on health benefits of reducing atmospheric sulfate aerosol concentrations, this study finds that annual US health benefits will be between \$3 billion and \$11 billion in 1997, and between \$12 billion and \$40 billion when the program is fully implemented in 2010. Available from the Acid Rain Hotline, 202-233-9620.

Acid Deposition Standard Feasibility Study

Report to Congress on the feasibility and effectiveness of a standard to protect sensitive ecosystems from acid deposition. Integrates ecological research, emission and source-receptor modeling, and implementation and cost evaluations. Available from the Acid Rain Hotline, 202 233-9620.

AIR TOXICS REDUCTION

Internet Resources

Unified Air Toxics Website - www.epa.gov/oar/oaqps/airtox

This site provides a wide range of information on EPA's air toxics program, including health effects information and plain-English fact sheets on air toxics regulations.

Appendix I: General Information About the Clean Air Act (cont.)

Written Materials

Risk Assessment for Toxic Air Pollutants: A Citizen's Guide

This short booklet describes in plain-English the process used in determining health risks associated with exposure to toxic air pollutants. Available from the EPA's Control Technology Center Hotline, 919 541-0800.

Evaluating Exposures to Toxic Air Pollutants: A Citizen's Guide

Exposure assessment is part of the risk assessment process. This short booklet describes in plain English how exposure assessment is used to determine to what extent and/or how many people are exposed to toxic air pollutants. Available from the EPA's Control Technology Center Hotline, 919 541-0800.

A Guidebook on How to Comply with the Chromium Electroplating and Anodizing National Emission Standards for Hazardous Air Pollutants (1995)

Provides general information on how to comply with the regulation to reduce air toxics emissions from chromium electroplating operations. EPA453-B-95-001. Available from the EPA's Control Technology Center Hotline, 919 541-0800.

Guidance Document for the Halogenated Solvent Cleaner National Emission Standards for Hazardous Air Pollutants (1995)

Provides general information on how to comply with the regulation to reduce air toxics emissions from halogenated solvent cleaning operations (degreasers). EPA453-R-04-081. Available from the EPA's Control Technology Center Hotline, 919 541-0800.

New Regulation Controlling Emissions From Dry Cleaners (1994)

This brochure provides general information on how to comply with the air toxics regulation for dry cleaners. EPA453-F-94-025. Available from the EPA's Control Technology Center Hotline, 919 541-0800.

The EPA Great Waters Program: An Introduction to the Issues and the Ecosystems (1994)

This short booklet provides basic information about how air pollution contributes to water quality problems in the "Great Waters," including the Great Lakes, Lake Champlain, the Chesapeake Bay and certain other coastal waters. EPA453-B-94-030. Available from the EPA's Control Technology Center Hotline, 919 541-0800.

Chemical Accident Prevention and Clean Air Act Amendments of 1990

General information concerning the provisions of the Clean Air Act relating to prevention and management of accidental chemical releases. Available from the Emergency Planning and Community Right-to-Know Hotline, 800 535-0202.

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies

EPA Regional Air Program Contacts

U.S. EPA Region 1

Air Quality Hotline
JFK Federal Building
Boston, MA 02203

Phone: 800 821-1237

U.S. EPA Region 2

Division of Environmental Planning and
Protection (DEPP)
Air Programs Branch
290 Broadway, 26th Floor
New York, NY 10007-1866

Phone: 212 637-3725

U.S. EPA Region 3

Air and Toxics Section
Air Protection Division
841 Chestnut Building
Philadelphia, PA 19107

Phone: 212 566-2691

U.S. EPA Region 4

Air, Pesticides, and Toxic Management
Division
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-3104

Phone: 404 562-9077

U.S. EPA Region 5

Air and Radiation Division
77 West Jackson Boulevard (A-18J)
Chicago, IL 60604

Phone: 312 353-2212

U.S. EPA Region 6

Multimedia Planning and Permitting
Division

Air Program

First Interstate Bank Tower
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Phone: 214 665-7200

U.S. EPA Region 7

Air, RCRA and Toxics Division
726 Minnesota Avenue
Kansas City, KS 66101

Phone: 913 551-7020

U.S. EPA Region 8

Pollution Prevention, State and Tribal
Assistance

Air Program

999 18th Street, Suite 500
Denver, CO 80202-2466

Phone: 303 312-6005

U.S. EPA Region 9

Air Division

75 Hawthorne Street
San Francisco, CA 94105

Phone: 415 744-1219

U.S. EPA Region 10

1200 Sixth Avenue
Seattle, WA 98101

Phone: 206 553-2963

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies (cont.)

State Air Pollution Control Agencies

ALABAMA

Department of Environmental Management
Air Division
1751 Congress WL Dickenson Drive
Montgomery, AL 36130
Phone: 334 271-7861

ALASKA

Department of Environmental
Conservation
Air and Water Quality Division
410 Willoughby Avenue, Suite 105
Juneau, AK 99801-1795
Phone: 907 465-5100

ARIZONA

Department of Environmental Quality
Air Quality Division
3033 North Central Avenue, Fifth Floor
Phoenix, AZ 85012
Phone: 602 207-2308

ARKANSAS

Department of Pollution Control and
Ecology
Air Division
8001 National Drive
P.O. Box 8913
Little Rock, AR 72219-8913
Phone: 501 682-0750

CALIFORNIA

Air Resources Board
P.O. Box 2815
Sacramento, CA 95812
Phone: 916 445-4383

COLORADO

Department of Health
Air Pollution Control Division B-1
4300 Cherry Creek Drive South
Denver, CO 80222-1530
Phone: 303 692-3100

CONNECTICUT

Department of Environmental Protection
Bureau of Air Management
79 Elm Street
Hartford, CT 06106
Phone: 860 424-3026

DELAWARE

Department of Natural Resources and
Environmental Control
Division of Air and Waste Management
Air Quality Management Section
156 South State Street
Dover, DE 19901
Phone: 302 739-4791

DISTRICT OF COLUMBIA

D.C. Department of Consumer and
Regulatory Affairs
Environmental Regulation Administration
Air Resources Management Division
2100 Martin Luther King Avenue, SE.,
Suite 203
Washington DC 20020-5732
Phone: 202 645-6093, ext. 3067

FLORIDA

Department of Environmental Protection
Air Resources Management
Mail Station 5500
2600 Blair Stone Road
Tallahassee, FL 32399-2400
Phone: 904 488-0114

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies (cont.)

GEORGIA

Department of Natural Resources
Environmental Protection Division
Air Protection Branch
4244 International Parkway, Suite 120
Atlanta, GA 30354
Phone: 404 363-7000

HAWAII

Department of Health
Clean Air Branch
P.O. Box 3378
Honolulu, HI 96801
Phone: 808 586-4200

IDAHO

Division of Environmental Quality
Permits and Enforcement
1410 North Hilton, Third Floor
Boise, ID 83706
Phone: 208 373-0502

ILLINOIS

Environmental Protection Agency
Bureau of Air
2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276
Phone: 217 785-4140

INDIANA

Department of Environmental Management
Office of Air Management
100 North Senate Avenue
Indianapolis, IN 46206-6015
Phone: 317 232-5586

IOWA

Department of Natural Resources
Air Quality Bureau
7900 Hickman Road, Suite One
Urbandale, IA 50322
Phone: 515 281-8852

KANSAS

Department of Health and Environment
Bureau of Air and Radiation
Forbes Field, Building 740
Topeka, KS 66620
Phone: 913 296-1593

KENTUCKY

Department for Environmental Protection
Division for Air Quality
803 Schenkel Lane
Frankfort, KY 40601
Phone: 502 573-3382

LOUISIANA

Department of Environmental Quality
Office of Air Quality and Radiation
Protection
P.O. Box 82135
Baton Rouge, LA 70884-2135
Phone: 504 765-0219

MAINE

Department of Environmental Protection
Bureau of Air Quality Control
State House, Station 17
Augusta, ME 04333
Phone: 207 287-2437

MARYLAND

Department of the Environment
Air and Radiation Management
Administration
2500 Broening Highway
Baltimore, MD 21224
Phone: 410 631-3255

MASSACHUSETTS

Department of Environmental Protection
Division of Air Quality Control
One Winter Street, Seventh Floor
Boston, MA 02108
Phone: 617 292-5630

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies (cont.)

MICHIGAN

Department of Environmental Quality
Air Quality Division
PO Box 30260
Lansing, MI 48909 -7760
Phone: 517 373-7023

MINNESOTA

Pollution Control Agency
Air Quality Division
520 Lafayette Road
St. Paul, MN 55155
Phone: 612 296-7331

MISSISSIPPI

Department of Environmental Quality
Office of Pollution Control
Air Division
P.O. Box 10385
Jackson, MS 39289
Phone: 601 961-5171

MISSOURI

Department of Natural Resources
Division of Environmental Quality
Air Pollution Control Program
P.O. Box 176
Jefferson City, MO 65102
Phone: 573 751-4817

MONTANA

Department of Environmental Quality
Air and Waste Management Bureau
Medcalf Building
P.O. Box 200901
Helena, MT 59620-0901
Phone: 406 444-3454

NEBRASKA

Department of Environmental Quality
Air and Waste Management Division
1200 North Street, Suite 400
P.O. Box 98922
Lincoln, NE 68509-8922
Phone: 402 471-0001

NEVADA

Division of Environmental Protection
Bureau of Air Quality
333 West Nye Lane
Carson City, NV 89710
Phone: 702 687-4670

NEW HAMPSHIRE

Department of Environmental Services
Air Resources Division
64 North Main Street
Caller Box 2033
Concord, NH 03301
Phone: 603 271-1370

NEW JERSEY

Department of Environmental Protection
Office of Air Quality Management
401 East State Street, Seventh Floor West
Trenton, NJ 08625
Phone: 609 292-6710

NEW MEXICO

Environmental Department
Environmental Protection Division
Air Quality Bureau
Harold Runnels Building
Room S2100
P.O. Box 26110
Santa Fe, NM 87502
Phone: 505 827-0031

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies (cont.)

NEW YORK

Department of Environmental
Conservation
Division of Air Resources
50 Wolf Road
Albany, NY 12233-3250
Phone: 518 457-7230

NORTH CAROLINA

Department of Environment, Health, and
Natural Resources
Division of Air Quality
P.O. Box 29580
Raleigh, NC 27626-0580
Phone: 919 715-6232

NORTH DAKOTA

Department of Health
Division of Environmental Engineering
1200 Missouri Avenue, Room 304
P.O. Box 5520
Bismarck, ND 58506-5520
Phone: 701 328-5188

OHIO

Environment Protection Agency
Division of Air Pollution Control
P.O. Box 1049
Columbus, OH 43216-0149
Phone: 614 644-2270

OKLAHOMA

Department of Environmental Quality
Air Quality Division
4545 North Lincoln Boulevard, Suite 250
Oklahoma City, OH 73105-3483
Phone: 405 290-8247

OREGON

Department of Environmental Quality
Air Quality Division
811 SW Sixth Avenue
Portland, OR 97204
Phone: 503 229-5359

PENNSYLVANIA

Department of Environmental Resources
Bureau of Air Quality Control
400 Market Street
P.O. Box 8468
Harrisburg, PA 17105-8468
Phone: 717 787-9702

RHODE ISLAND

Department of Environmental Management
Division of Air Resources
235 Promenade Street
Providence, RI 02908-5767
Phone: 401 277-2808

SOUTH CAROLINA

Department of Health and Environmental
Control
Bureau of Air Quality Control
2600 Bull Street
Columbia, SC 29201
Phone: 803 734-4750

SOUTH DAKOTA

Department of Environmental and Natural
Resources
Air and Surface Water Program
523 East Capitol Avenue
Joe Foss Building
Pierre, SD 57501
Phone: 605 773-3351

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies (cont.)

TENNESSEE

Department of Environment and
Conservation
Division of Air Pollution Control
401 Church Street, Ninth Floor
L & C Annex
Nashville, TN 37243-1531
Phone: 615 532-0554

TEXAS

Texas Natural Resource Conservation
Commission
Office of Policy and Regulatory
Development
P.O. Box 13087
Austin, TX 78711-3087
Phone: 512 239-5818

UTAH

Department of Environmental Quality
Division of Air Quality
150 North 1950 West
Salt Lake City, UT 84114-4820
Phone: 801 536-4000

VERMONT

Agency of Natural Resources
Air Pollution Control Division
103 South Main Street
Building Three South
Waterbury, VT 05676
Phone: 802 241-3840

VIRGINIA

Department of Environmental Quality
Air Division
P.O. Box 10009
Richmond, VA 23240
Phone: 804 698-4311

WASHINGTON

Department of Ecology
Air Program
P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360 407-6800

WEST VIRGINIA

Division of Environmental Protection
Office of Air Quality
1558 Washington Street, East
Charleston, WV 25311
Phone: 304 558-3286

WISCONSIN

Department of Natural Resources
Bureau of Air Management (AM/10)
P.O. Box 7921
Madison, WI 53707
Phone: 608 266-7718

WYOMING

Department of Environmental Quality
Air Quality Division
122 West 25th Street
Cheyenne, WY 82002
Phone: 307 777-7391

AMERICAN SAMOA

Environmental Quality Commission
Governor's Office
Pago Pago, AS 96799
Phone: 684 633-4116

GUAM

Environmental Protection Agency
Air Pollution Program
Harmon Plaza
Complex Unit D-107
130 Rojas Street
Harmon, GU 96911
Phone: 671 646-8863

Appendix II: EPA Regional Air Program Contacts and State Air Pollution Control Agencies (cont.)

PUERTO RICO

Environmental Quality Board

Air Program

Ponce de Leon Avenue #431

Hato Rey, PR 00917

Phone: 809 767-8129

VIRGIN ISLANDS

Division of Environmental Protection

Department of Planning and Natural
Resources

396-1 Foster Plaza

Annas Retreat

Charlotte Amalie

St. Thomas, VI 00802

Phone: 809 774-3320

Appendix III: Summary of Airborne Emission Regulations for Hazardous Waste Management Units

Subpart AA regulates organic emissions from process vents associated with distillation, fractionation, thin film evaporation, solvent extraction, and air or stream stripping operations.¹ Subpart AA only applies to these types of units managing hazardous waste streams with organic concentration levels of at least 10 parts per million by weight (ppmw). Subpart AA regulations require facilities with covered process vents to either reduce total organic emissions from all affected process vents at the facility to below 3 lb/h and 3.1 tons/year, or reduce emissions from all process vents by 95 percent through the use of a control device, such as a closed-vent system, vapor recovery unit, flare, or other combustion unit.

Subpart BB sets inspection and maintenance requirements for equipment, such as valves, pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, flanges, or control devices that contain or contact hazardous wastes with organic concentrations of at least 10 percent by weight.² Subpart BB does not establish numeric criteria for reducing emissions, it simply establishes monitoring, leak detection, and repair requirements.

Subpart CC establishes controls on tanks, surface impoundments, and containers in which hazardous waste has been placed.³ It applies only to units containing hazardous waste with an average organic concentration greater than 500 ppmw. Units managing hazardous waste that has been treated to reduce the concentrations of organics by 95 percent are exempt. Non-exempt surface impoundments must have either a rigid cover or, if wastes are not agitated or heated, a floating membrane cover. Closed vent systems are required to control the emissions from covered surface impoundments. These control systems must achieve the same 95 percent emission reductions described above under Subpart AA.

¹40 CFR §§ 264.1030-1036.

²40 CFR §§ 264.1050-1065.

³40 CFR §§ 264.1080-1091.

Appendix IV: Example List of Chemical Suppressants⁴

Type	Product	Manufacturer
Bitumens	AMS 2200, 2300®	Arco Mine Sciences
	CohereX®	Witco Chemical
	Docal 1002®	Douglas Oil Company
	Penepriime®	Utah Emulsions
	Petro Tac P®	Syntech Products Corporation
	Resinex®	Neyra Industries, Inc.
	Retain®	Dubois Chemical Company
Salts	Calcium chloride	Allied Chemical Corporation
	Dowflake, Liquid Dow®	Dow Chemical
	DP-10®	Wen-Don Corporation
	Dust Ban 8806®	Nalco Chemical Company
	Dustgard®	G.S.L. Minerals and Chemicals Corporation
	Sodium silicate	The PQ Corporation
Adhesives	Acrylic DLR-MS®	Rohm and Haas Company
	Bio Cat 300-1®	Applied Natural Systems, Inc.
	CPB-12®	Wen-Don Corporation
	Curasol AK®	American Hoechst Corporation
	DCL-40A, 1801, 1803®	Calgon Corporation
	DC-859, 875®	Betz Laboratories, Inc.
	Dust Ban®	Nalco Chemical Company
	Flambinder®	Flambeau Paper Company
	Lignosite®	Georgia Pacific Corporation
	Norlig A, 12®	Reed Lignin, Inc.
	Orzan Series®	Crown Zellerbach Corporation
	Soil Gard®	Walsh Chemical

Source: U.S. EPA. 1989. Hazardous Waste TSDF—Fugitive Particulate Matter Air Emissions Guidance Document. EPA450-3-89-019.

⁴Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use.

Appendix III: Summary of Airborne Emission Regulations for Hazardous Waste Management Units

Subpart AA regulates organic emissions from process vents associated with distillation, fractionation, thin film evaporation, solvent extraction, and air or stream stripping operations.¹ Subpart AA only applies to these types of units managing hazardous waste streams with organic concentration levels of at least 10 parts per million by weight (ppmw). Subpart AA regulations require facilities with covered process vents to either reduce total organic emissions from all affected process vents at the facility to below 3 lb/h and 3.1 tons/year, or reduce emissions from all process vents by 95 percent through the use of a control device, such as a closed-vent system, vapor recovery unit, flare, or other combustion unit.

Subpart BB sets inspection and maintenance requirements for equipment, such as valves, pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, flanges, or control devices that contain or contact hazardous wastes with organic concentrations of at least 10 percent by weight.² Subpart BB does not establish numeric criteria for reducing emissions, it simply establishes monitoring, leak detection, and repair requirements.

Subpart CC establishes controls on tanks, surface impoundments, and containers in which hazardous waste has been placed.³ It applies only to units containing hazardous waste with an average organic concentration greater than 500 ppmw. Units managing hazardous waste that has been treated to reduce the concentrations of organics by 95 percent are exempt. Non-exempt surface impoundments must have either a rigid cover or, if wastes are not agitated or heated, a floating membrane cover. Closed vent systems are required to control the emissions from covered surface impoundments. These control systems must achieve the same 95 percent emission reductions described above under Subpart AA.

¹40 CFR §§ 264.1030-1036.

²40 CFR §§ 264.1050-1065.

³40 CFR §§ 264.1080-1091.

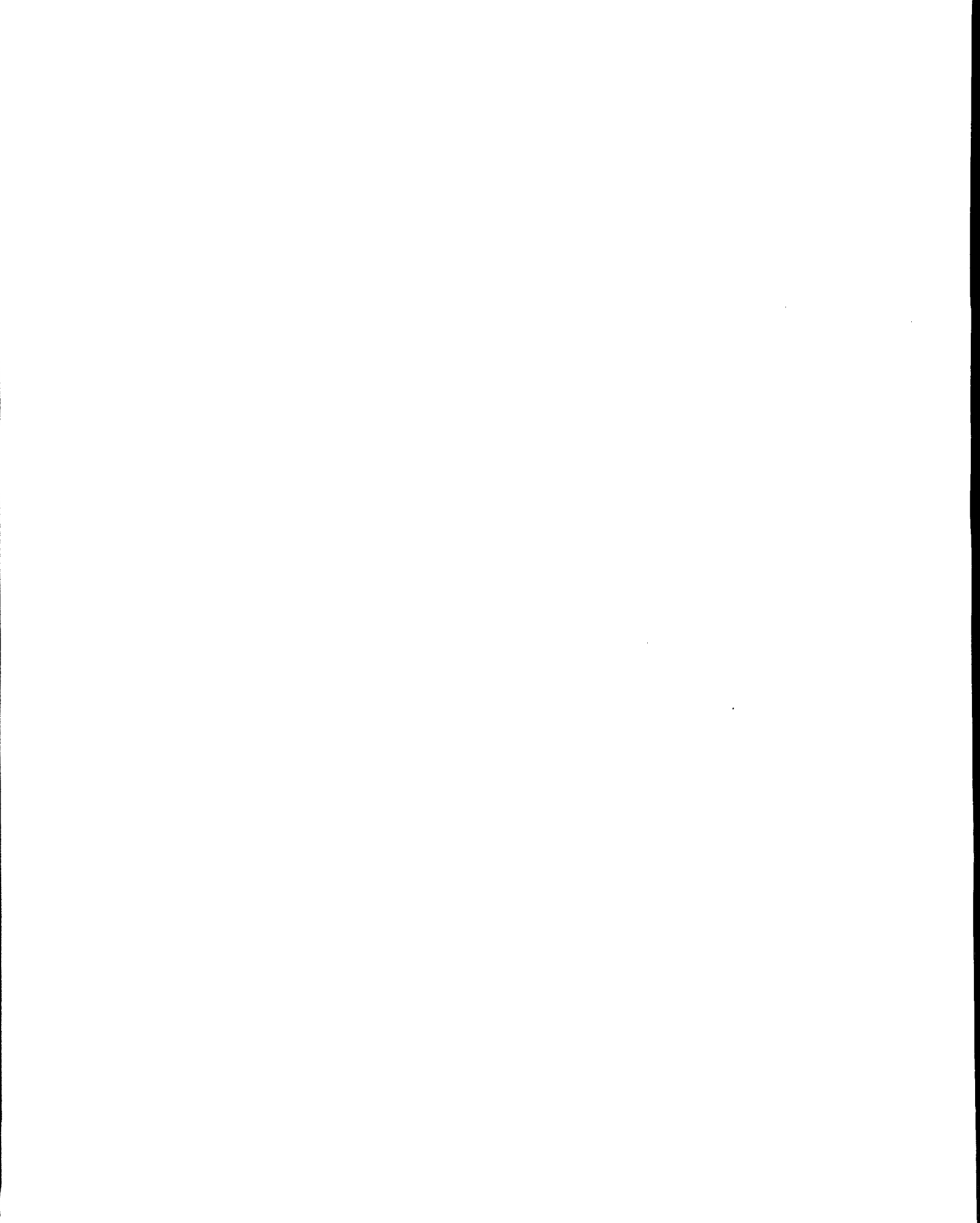
Appendix IV: Example List of Chemical Suppressants⁴

Type	Product	Manufacturer
Bitumens	AMS 2200, 2300®	Arco Mine Sciences
	Coherex®	Witco Chemical
	Docal 1002®	Douglas Oil Company
	Penepriime®	Utah Emulsions
	Petro Tac P®	Syntech Products Corporation
	Resinex®	Neyra Industries, Inc.
	Retain®	Dubois Chemical Company
Salts	Calcium chloride	Allied Chemical Corporation
	Dowflake, Liquid Dow®	Dow Chemical
	DP-10®	Wen-Don Corporation
	Dust Ban 8806®	Nalco Chemical Company
	Dustgard®	G.S.L. Minerals and Chemicals Corporation
	Sodium silicate	The PQ Corporation
Adhesives	Acrylic DLR-MS®	Rohm and Haas Company
	Bio Cat 300-1®	Applied Natural Systems, Inc.
	CPB-12®	Wen-Don Corporation
	Curasol AK®	American Hoechst Corporation
	DCL-40A, 1801, 1803®	Calgon Corporation
	DC-859, 875®	Betz Laboratories, Inc.
	Dust Ban®	Nalco Chemical Company
	Flambinder®	Flambeau Paper Company
	Lignosite®	Georgia Pacific Corporation
	Norlig A, 12®	Reed Lignin, Inc.
	Orzan Series®	Crown Zellerbach Corporation
	Soil Gard®	Walsh Chemical

Source: U.S. EPA. 1989. Hazardous Waste TSD—Fugitive Particulate Matter Air Emissions Guidance Document. EPA450-3-89-019.

⁴Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use.

PROTECTING SURFACE WATER
APPENDICES



Appendix I: Pretreatment Fact Sheet and FAQ

Industrial Pretreatment

The National Pretreatment Program is a cooperative effort of federal, state, and local regulatory environmental agencies established to protect water quality. The program is designed to reduce the level of pollutants discharged by industry and other non-domestic wastewater sources into municipal sewer systems, and thereby, reduce the amount of pollutants released into the environment through wastewater. The objectives of the program are to protect the Publicly Owned Treatment Works (POTW) from pollutants that may interfere with plant operation, to prevent pollutants that may pass through untreated from being introduced into the POTW, and to improve opportunities for the POTW to reuse wastewater and sludges that are generated. The term "pretreatment" refers to the requirement that nondomestic sources discharging wastewater to POTWs control their discharges, and meet limits established by EPA, the State, or local authority on the amount of pollutants allowed to be discharged. The control of the pollutants may necessitate treatment prior to discharge to the POTW (therefore the term "pretreatment"). Limits may be met by the nondomestic source through pollution prevention techniques (product substitution recycle and reuse of materials) or treatment of the wastewater.

Program objectives are:

To prevent industrial facilities' pollutant discharges from passing through municipal wastewater treatment plants untreated;

To protect treatment plants from the threat posed by untreated industrial wastewater, including explosion, fire, and interference with the treatment process; and

To improve the quality of effluents and sludges so that they can be used for beneficial purposes.

There are more than 1500 publicly owned treatment works that are required to implement local pretreatment programs. By reducing the level of pollutants discharged by industry into municipal sewage systems, the program ensures the protection of America's multi-billion dollar public investment in treatment infrastructure.

Pretreatment Facts:

REGULATORY PROVISIONS

General PT Regulations (40 CFR Part 403)

- Objectives: prevent pass through and interference (including preventing interference with sludge use and disposal); promote beneficial re-use of effluents and sludges. (See 403.2)
- National prohibited discharge standards: temperature, pH, explosive, etc. (See 403.5)
- Application of national categorical pretreatment standards (See 403.6)
- Requirements for State and local Publicly Owned Treatment Works (POTW) programs (See 403.8(f) and 403.10)
- Reporting requirements for POTWs and Industrial Users (IU) (See 403.12)

Appendix I: Pretreatment Fact Sheet and FAQ (cont.)

- Other requirements (e.g., FDF variances, net/gross adjustments) (See 403.13 - 403.17)
- Categorical Pretreatment Standards (40 CFR Parts 405 - 471)

PROGRAM STATUS

- 31 of 42 NPDES States have approved Pretreatment programs.
- Approximately 1600 POTWs are required to implement Pretreatment programs.
- Pretreatment POTWs receive 80% of national wastewater flow (~ 30 billion gals/day).
- An estimated 270,000 Industrial Users (IUs) discharge to POTWs, of which there are 31,842 Significant Industrial Users (SIUs); 14,914 of the SIUs are subject to categorical standards; 16,928 of the remaining SIUs are defined by one of the following criteria: 25,000 gallons per day process flow; 5% of hydraulic or organic flow of POTW; reasonable potential to cause pass through or interference.

Industrial Pretreatment - Frequently Asked Questions

Q: What is the National Pretreatment Program?

A: The National Pretreatment Program is designed to reduce the amount of pollutants discharged by industry and other non-domestic wastewater sources into municipal sewer systems, and thereby, reduce the amount of pollutants released into the environment from publicly owned wastewater treatment plants. The program is a cooperative effort of federal, state, and local regulatory environmental agencies established to protect water quality. The objectives of the program are to protect the Publicly Owned Treatment Works (POTW) or municipal wastewater treatment facility from pollutants that may interfere with plant operation or pass through the plant untreated and to improve opportunities for the POTW to reuse treated wastewater and sludges (biosolids) that are generated. The term "pretreatment" refers to pollutant control requirements for nondomestic sources discharging wastewater to sewer systems that are connected to POTWs. Limits on the amount of pollutants allowed to be discharged are established by EPA, the State, or the local authority. Pretreatment limits may be met by the industry through pollution prevention (e.g., production substitution, recycling and reuse of materials) or treatment of the wastewater.

Q: Under what Statutory Authority is the Pretreatment Program Administered?

A: The National Pretreatment Program's authority comes from section 307 of the Federal Water Pollution Control Act (more commonly referred to as the Clean Water Act). The federal government's role in pretreatment began with the passage of the Clean Water Act in 1972. The Act called for EPA to develop national pretreatment standards to control industrial discharges into sewerage systems.

Appendix I: Pretreatment Fact Sheet and FAQ (cont.)

Q: Are there any prescribed National Standards for Pretreatment?

A: There are two sets of standards: "categorical Pretreatment Standards" and "Prohibited Discharge Standards." These are uniform national requirements which restrict the level of pollutants that may be discharged by nondomestic sources to sanitary sewer systems. All POTWs that are required to implement a Pretreatment Program must enforce the federal standards.

Q: What are Categorical Pretreatment Standards?

A: These are technology-based limitations on pollutant discharges to POTWs promulgated by EPA in accordance with Section 307 of the Clean water Act that apply to specified process wastewaters of particular industrial categories [see 40 CFR 403.6 and 40 CFR Parts 405- 471]

Q: What are Prohibited Discharge Standards?

A: These are standards that prohibit the discharge of wastes that pass through or interfere with POTW operations (including sludge management). These are the general prohibitions. There are also specific prohibitions that prohibit the discharge from all nondomestic sources certain types of wastes that 1) create a fire or explosion hazard in the collection system or treatment plant, 2) are corrosive, including any discharge with a pH less than 5.0, unless the POTW is specifically designed to handle such wastes, 3) are solid or viscous pollutants in amounts that will obstruct the flow in the collection system and treatment plant, resulting in interference with operations, 4) any pollutant discharged in quantities sufficient to interfere with POTW operations, and 5) discharges with temperatures above 140° F (40° C) when they reach the treatment plant, or hot enough to interfere with biological processes.

Q: When were the federal regulations governing pretreatment program requirements first promulgated and where can I find them?

A: The General Pretreatment Regulations were originally published in 1978, and have been updated several times (the latest changes were made on July 17, 1997) and can be found in the Code of Federal Regulations in 40 CFR Part 403.

Appendix II: State Storm-water Offices

ALABAMA

Alabama Dept. of Environmental
Management Industrial Section
P.O. Box 301463
Montgomery, AL 36130-1463
Phone: 334 271-7847

ALASKA

Department of Environmental
Conservation
Division of Air and Water Quality
410 Willovenby Avenue
Juneau, AK 99801-1795
Phone: 907 465-5300
Fax Number: 907 465-5274

ARIZONA

Arizona Department of Water Resources
Flood Mitigation Department
500 North Third Street
Phoenix, AZ 85004
Phone: 602 417-2445
Fax: 602 417-2401
Internet: [www.adwr.state.az.us/about/
address.html](http://www.adwr.state.az.us/about/address.html)

ARKANSAS

Department of Pollution Control and
Ecology
P.O. Box 8913
Little Rock, AR 72219-8913
Phone: 501 682-0744

CALIFORNIA

State Water Resources Control Board
Division of Water Quality
Attention: Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977
Phone: 916 657-0919
Fax: 916 657-1011
Internet: www.swrcb.ca.gov/storm.htm

COLORADO

Colorado Dept. of Public Health &
Environment
Water Quality Control Division
4300 Cherry Creek Drive South
Denver, CO 80222-1530
Phone: 303 692-3500

CONNECTICUT

Department of Environmental Protection
Bureau of Water Management
79 Elm Street
Hartford, CT 06106-5127
Phone: 860 424-3850
Internet: dep.state.ct.us/Water/strategc.htm

DELAWARE

Dept. of Natural Resources and Envir.
Control
Division of Water Resources
Surface Water Discharges Section
89 Kings Highway
Dover, DE 19901
Phone: 302-739-5731
Internet: www.dnrec.state.de.us/twater.htm

FLORIDA

No state authority. Contact EPA Region 4:
U.S. EPA Region 4
Surface Water Permits and Facilities Branch
Water Management Division
61 Forsyth Street, SURFACE WATER.
Atlanta, Georgia 30303-3104
Phone: 404 562-9280
Fax: 404 562-8692

GEORGIA

Department of Natural Resources
Environmental Protection Division
Nonpoint Source Program
Floyd Tower East, Suite 1070
205 Butler Street, SE.
Atlanta, GA 30334
Phone: 404 656-4887
Internet: www.georgianet.org/dnr/

Appendix II: State Storm-water Offices (cont.)

HAWAII

Department of Health
Clean Water Branch
Engineering Section
919 Ala Moana Boulevard, Room 301
Honolulu, HI 96814-4920

Phone: 808 586-4309

IDAHO

No state authority. Contact EPA Region 10:
U.S. EPA Region 10
Office of Water
NPDES Permits Unit
1200 Sixth Avenue
Seattle, WA 98101

Phone: 206 553-1448

ILLINOIS

Illinois Department of Natural Resources
Office of Water Resources
524 South Second Street
Springfield, IL 62701-1787

Phone: 217 782-3863

Internet: dnr.state.il.us/ildnr/offices/water.htm

INDIANA

Department Of Environmental Management
NPDES Permits Group
105 South Meridian Street
Indianapolis, IN 46206

Phone: 317 232-8603

IOWA

Storm Water Permit Coordinator
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319

Phone: 515 281-7017

KANSAS

Kansas Department of Health and
Environment
Bureau of Water
Building 283—Forbes Field
Topeka, KS 66620

Phone: 785 296-5557

Internet: www.state.ks.us/public/kdhe/bow.html

KENTUCKY

Kentucky Dept. for Environmental
Protection
Division of Water
KPDES Branch
14 Reilly Road
Frankfort, KY 40601

Phone: 502 564-3410

Internet: www.state.ky.us/agencies/nrepc/dow/dwkpdes.htm

LOUISIANA

Department of Environmental Quality
Office of Water Resources
P.O. Box 82215
Baton Rouge, LA 70884-2215

Phone: 504 765-0525

MAINE

Department of Environmental Protection
Bureau of Land and Water Quality
Water Resource Regulation Division
17 State House Station
Augusta, ME 04333-0017

Phone: 207 287-3901

Internet: www.state.me.us/dep/whoswho.htm

Appendix II: State Storm-water Offices (cont.)

MARYLAND

Maryland Department of the Environment
Water Management Administration
Nonpoint Source Permits Program
2500 Broenig Highway
Baltimore, MD 21224

Phone: 410 631-3566

Internet: www.mde.state.md.us/current/regcal.html

MASSACHUSETTS

Department of Environmental Protection
Bureau of Resource Protection
Division of Water Supply
One Winter Street, Ninth Floor
Boston, MA 02108-4747

Phone: 617 556-1143

MICHIGAN

Michigan Dept. Of Environmental Quality
Surface Water Quality Division
Permits Program
P.O. Box 30273
Lansing, MI 48909

Phone: 517 373-1982

MINNESOTA

Department of Natural Resources
Division of Waters
Water Quality Division
520 Lafayette Road North
St. Paul, MN 55155

Phone: 612-296-8280

MISSISSIPPI

Department of Environmental Quality
Office of Land and Water Resources
2380 Highway 80 West
Jackson, MI 39204

Phone: 601 961-5234

MISSOURI

Department of Natural Resources
Division of Environmental Quality
Water Pollution Control Program
P.O. Box 176
Jefferson City, MO 65102

Phone: 573 526-2928

MONTANA

Department of Environmental Quality
Permitting and Compliance Division
P.O. Box 200901
Helena, MT 59620

Phone: 406 444-5329

NEBRASKA

Department of Environmental Quality
1200 N Street, Suite 400
Lincoln, NE 68509

Phone: 402 471-2023

NEVADA

Dept. of Conservation and Natural
Resources
Environmental Protection Division
333 West Nye Lane, Room 129
Carson City, NV 89706-0851

Phone: 702 687-4670, Ext. 3149

NEW HAMPSHIRE

Department of Environmental Services
Water Division
64 North Main Street, Third Floor
Concord, NH 03301

Phone: 603 271-2457

NEW JERSEY

Department of Environmental Protection
Division of Water Quality
401 East State Street, Third Floor
P.O. Box 029
Trenton, NJ 08625

Phone: 609 633-7021

Appendix II: State Storm-water Offices (cont.)

NEW MEXICO

New Mexico Environment Department
Surface Water Quality Division
P.O. Box 26110
Santa Fe, NM 87502
Phone: 505 827-2827

NEW YORK

Department of Environmental
Conservation
Division of Water
50 Wolf Road, Room 314
Albany, NY 12233-3505
Phone: 518 457-0624
Internet: www.dec.state.ny.us/website/pollution/water.html

NORTH CAROLINA

Dept. of Environment and Natural
Resources
Division of Water Quality
Water Quality Section
P.O. Box 29535
Raleigh, NC 27626-0535
Phone: 919 733-5083, ext. 525

NORTH DAKOTA

Department of Health
Environmental Engineering Division
James Collins
1200 Missouri Avenue, Room 203
Bismarck, ND 58506-5520
Phone: 701 328-5210

OHIO

Ohio EPA
Division of Surface Water
Storm water Section
P.O. Box 1049
Columbus, OH 43216-1049
Phone: 614 644-2034

OKLAHOMA

Oklahoma Dept. of Environmental Quality
Water Quality Program
1000 N.E. 10th St., WQS 0207
Oklahoma City, OK 73117-1212
Phone: 405-271-7339

OREGON

Storm Water Coordinator
Department of Environmental Quality
Water Quality Division
811 SURFACE WATER, Sixth Avenue
Portland, OR 97204
Phone: 800 452-4011

PENNSYLVANIA

Department of Environmental Protection
Bureau of Water Quality Protection
Division of Wastewater Management
RCSOB, Eleventh Floor
P.O. Box 8774
Harrisburg, PA 17105-8774
Phone: 717 787-8184

RHODE ISLAND

Department of Environmental Management
Water Resources - Permitting
235 Promenade Street
Providence, RI 02908
Phone: 401 277-6820 ext. 7710
Fax: 401 277-6177

SOUTH CAROLINA

Department of Health and Environmental
Control
Industry and Agriculture
Waste Water Division
2600 Bull Street
Columbia, SC 29201
Phone: 803 734-9250

Appendix II: State Storm-water Offices (cont.)

SOUTH DAKOTA

Dept. of Environment and Natural
Resources
Surface Water Quality
523 East Capital
Pierre, SD 57501-3181
Phone: 800 SD-STORM (737-8676)

TENNESSEE

Department of Environment and
Conservation
Division of Water Pollution Control
401 Church Street, Sixth Floor
Nashville, TN 37243
Phone: 615 532-0669

TEXAS

Texas Natural Resources Conservation
Commission
Water Resource Management
Water Quality Division, Permits
Department (MC 150)
P.O. Box 13087
Austin, TX 78711-3087
Phone: 512 239-4433

UTAH

Utah Department of Natural Resources
Division of Water Resources
1594 West North Temple
P.O. Box 146201
Salt Lake City, Utah 84114-6201
Phone: 801 538-7230
Internet: [www.nr.state.ut.us/wtrresc/
wtrresc.htm](http://www.nr.state.ut.us/wtrresc/wtrresc.htm)

VERMONT

Chief, Storm Water Section
Department of Environmental
Conservation
103 South Main Street, Sewing Building
Waterbury, VT 05671-0405
Phone: 802 244-3822

VIRGINIA

Division of Environmental Quality
State Water Control Board
Permits Section
629 East Main Street
Richmond, VA 23219
Phone: 804 698-4086

WASHINGTON

Department of Ecology
Water Quality Division
P.O. Box 47600
Olympia, WA 98594-7600
Phone: 360 407-6000

WEST VIRGINIA

Division of Environmental Protection
Office of Water Resources
1201 Greenbriar Street
Charleston, WV 25311
Phone: 304 558-0375

WISCONSIN

Department of Natural Resources
Bureau of Watershed Management
P.O. Box 7921
Madison, WI 53707
Phone: 608 267-8525

WYOMING

Department of Environmental Quality
122 West 25th Street
Cheyenne, WY 82002
Phone: 307 777-7570

Appendix III: NPDES Fact Sheet and FAQ

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) PROGRAM

The Clean Water Act requires that all discharges from any point source into waters of the United States must obtain an NPDES permit. By point sources, EPA means discrete conveyances such as pipes or man made ditches. This does not necessarily mean that a household must obtain a permit to connect to a city sewer, but the facilities where discharges go directly into surface waters must obtain a permit. The reason for obtaining a permit is to protect public health and the nation's waters. The discharges that pose the most threat to public health and the nation's waters are: human wastes, ground-up food from sink disposals, laundry and bath waters, toxic chemicals and metals. Also, fecal coliform, oil and grease, pesticides, and metals are types of pollutants that when discharged into the nation's waters threaten both the health of humans and life forms in the water. If left untreated, the nation would be unable to enjoy its largest natural resource, water. Permitting, while it is regulatory, ensures that the nation's waters will be ever-improving and safe today as well as tomorrow.

National Pollutant Discharge Elimination System (NPDES) Permit Program

The Clean Water Act requires wastewater dischargers to have a permit establishing pollution limits, and specifying monitoring and reporting requirements. National Pollutant Discharge Elimination System (NPDES) permits regulate household and industrial wastes that are collected in sewers and treated at municipal wastewater treatment plants. Permits also regulate industrial point sources and concentrated animal feeding operations that discharge into other wastewater collection systems, or that discharge directly into receiving waters. More than 200,000 sources are regulated by NPDES permits nationwide.

Permits regulate discharges with the goals of 1) protecting public health and aquatic life, and 2) assuring that every facility treats wastewater. To achieve these ends, permits include the following terms and conditions:

Site-specific discharge (or effluent) limits;
Standard and site-specific compliance monitoring and reporting requirements; and
when and if regulated facilities fail to comply with the provisions of their permits, they may be subject to enforcement actions. EPA uses a variety of techniques to monitor permittees' compliance status, including on-site inspections and review of data submitted by permittees.

TYPES OF REGULATED POLLUTANTS

CONVENTIONAL POLLUTANTS are contained in the sanitary wastes of households, businesses, and industries. These pollutants include human wastes, ground-up food from sink disposals, and laundry and bath waters. Conventional pollutants include:

Fecal Coliform - These bacteria are found in the digestive tracts of humans and animals; their presence in water indicates the potential presence of pathogenic organisms.

Oil and Grease - These organic substances may include hydrocarbons, fats, oils, waxes, and

Appendix III: NPDES Fact Sheet and FAQ (cont.)

high-molecular fatty acids. Oil and grease may produce sludge solids that are difficult to process.

TOXIC POLLUTANTS are particularly harmful to animal or plant life. They are primarily grouped into organics (including pesticides, solvents, polychlorinated biphenyls (PCBs), and dioxins) and metals (including lead, silver, mercury, copper, chromium, zinc, nickel, and cadmium).

NONCONVENTIONAL POLLUTANTS are any additional substances that are not conventional or toxic that may require regulation. These include nutrients such as nitrogen and phosphorus.

NPDES Watershed Strategy

A NPDES Watershed Strategy has been developed to ensure that the NPDES Program protects watersheds as effectively as possible.

OWM developed the NPDES Watershed Strategy with input from States and EPA Regions. The final strategy reflects a first step towards the Office of Water's goal of fully integrating the NPDES permitting program into the Agency's broader Water Protection Approach.

The Watershed Strategy identifies six areas that must be addressed to improve water quality on a watershed basis nationwide, including:

Statewide coordination: Support the development of State-wide basin management frameworks, and coordinate interstate basin efforts to facilitate implementation of the Watershed Protection Approach.

NPDES Permits: Streamline the process for NPDES permit development, issuance, and review, and develop innovative approaches to permitting on a watershed basis where feasible.

Monitoring and assessment: Develop a state-wide monitoring strategy, and establish point-source ambient monitoring requirements.

Programmatic measures and environmental indicators: Revise existing national accountability measures to facilitate implementation of the Watershed Protection Approach.

Public participation: Utilize existing NPDES public participation process in development of watershed protection plans, and seek broad public participation in identifying local environmental goals.

Enforcement: Include emphasis on facilities that discharge to priority basins.

Appendix III: NPDES Fact Sheet and FAQ (cont.)

Implementation of the Watershed Strategy is now underway, and will include the completion of assessments of each State's watershed protection activities and needs. OWM will coordinate with other EPA Offices and States to ensure that ongoing program activities take watershed planning into consideration.

Wet Weather

Chief among the NPDES Program's responsibilities is the effective implementation of EPA's wet-weather strategies, including storm water management and the control of combined sewer and sanitary sewer overflows.

NPDES Storm Water Program

Storm water discharges from many sources are largely uncontrolled. For this reason, the mandate of the Storm Water Program is particularly challenging.

Amendments to the Clean Water Act established a two-phased approach to addressing storm water discharges. Phase I, currently being implemented, requires permits for separate storm water systems serving large- and medium-sized communities (those with over 100,000 inhabitants), and for storm water discharges associated with industrial and construction activity involving at least five acres.

To address the large number of industrial dischargers of storm water--at over 100,000 facilities--EPA has developed a strategy with a tiered framework to control the administrative burden while emphasizing reduction in risk to human health and ecosystems.

Phase II, which is currently under development, will address remaining storm water discharges. Ultimately, millions of potential permittees will be covered, including urban areas with populations under 100,000, smaller construction sites, and retail, commercial, and residential activities.

NPDES Program: Combined Sewer Overflows (CSOs)

In April 1994, EPA issued a policy for the control of combined sewer overflows. The policy calls for communities with CSOs to take immediate and long-term actions to address these overflow problems. Measures specified in the policy include proper operation and regular maintenance of sewer systems and CSOs, as well as the public notice in the event of overflows, to ensure that the public receives adequate notification of the impact of this health and environmental hazard.

Despite its rigorous approach to controlling combined sewer overflows, the CSO Control Policy provides communities with the flexibility to develop a workable, cost-effective solution to a major environmental problem. With significant input from key stakeholders, OWM is currently developing guidances to assist communities to implement measures for the control of CSOs as effectively as possible.

Appendix III: NPDES Fact Sheet and FAQ (cont.)

NPDES Program: Sanitary Sewer Overflows

EPA is currently in the process of evaluating the extent of sanitary sewer overflows across the country. The Agency will work with the public and with constituent groups across the country to identify and evaluate issues associated with these overflows to protect human health, property, and water quality.

NPDES Permit Program - Frequently Asked Questions

1. Who needs a NPDES Permit?

Any person discharging pollutants from a point source (direct industrial discharge or municipal wastewater) into the waters of the United States. The permit will probably contain limits on what you can discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality.

2. Where do I apply for a NPDES permit?

In most States, the State environmental protection office issues NPDES permits. A few States haven't yet received EPA approval to issue NPDES permits, and in those States you get a permit from an EPA regional office. You may also need to get a State permit from these States.

Here is who you should contact:

EPA Headquarters: NPDES Branch - (202) 260-9541
EPA Regions
State Contacts

The States that do not have permits are:

Alaska (contact EPA Region X)
Arizona (contact Region IX)
Idaho (contact Region X)
Maine (contact Region I)
Massachusetts (contact Region I)
New Hampshire (contact Region I)
New Mexico (contact Region VI)
Texas (contact Region VI)
District of Columbia (contact Region III)
Puerto Rico (contact Region II)
Pacific Territories (contact EPA Region IX)
Federal Indian Reservations (contact the EPA Regional Office where the Tribe is located)

Appendix III: NPDES Fact Sheet and FAQ (cont.)

3. Which States have EPA's approval to issue NPDES permits?

4. Is it legal to have wastewater coming out of a pipe into my local receiving water (eg.lake,stream,river,wetland)?

As long as the wastewater being discharged is covered by and in compliance with an NPDES permit, there are enough controls in place to make sure the discharge is safe and that humans and aquatic life are being protected. To find out if a discharge is covered by an NPDES permit, call the EPA Regional office or the State office responsible for issuing NPDES permits.

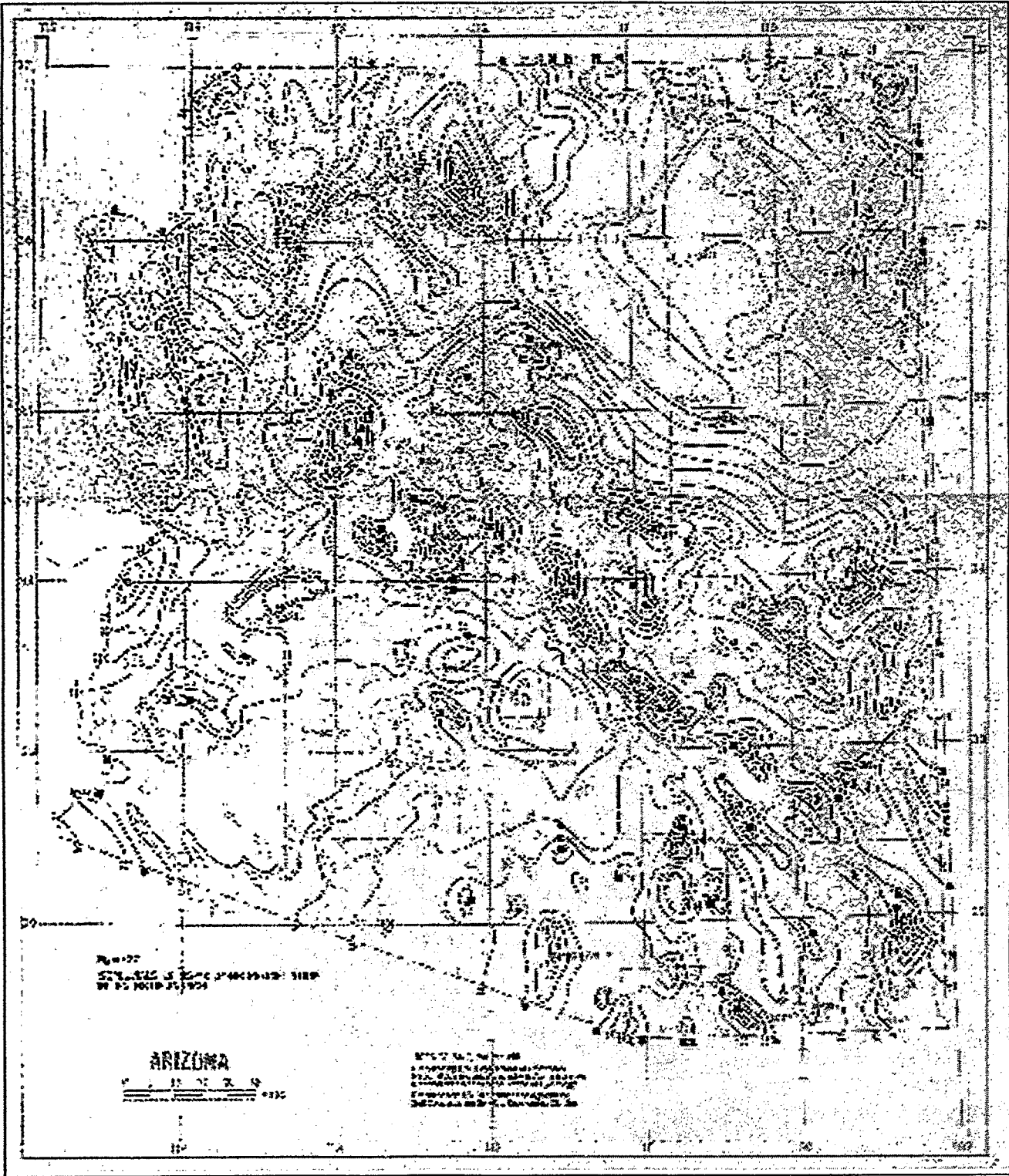
5. How do NPDES permits protect water?

An NPDES permit will generally specify an acceptable level of a pollutant or pollutant parameter in a discharge (for example, a certain level of bacteria). The permittee may choose which technologies to use to achieve that level. Some permits, however, do contain certain generic 'best management practices' (such as installing a screen over the pipe to keep debris out of the waterway). Make sure that the States mandatory standards for clean water and the federal minimums are being met.

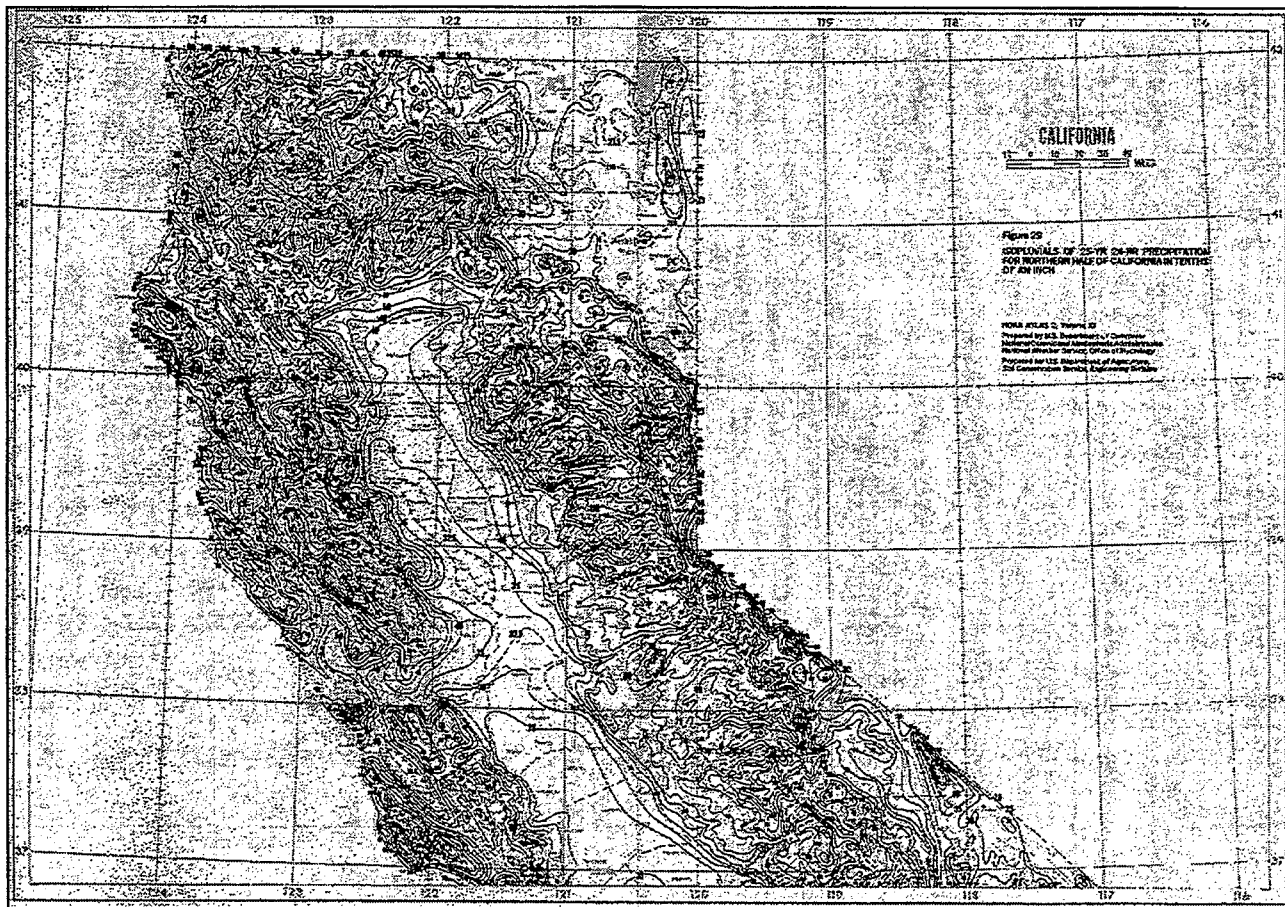
6. Is there any information available to me on permits in my area?

Yes, there is a national system that provides certain permitting information called the Permits Compliance System (PCS).

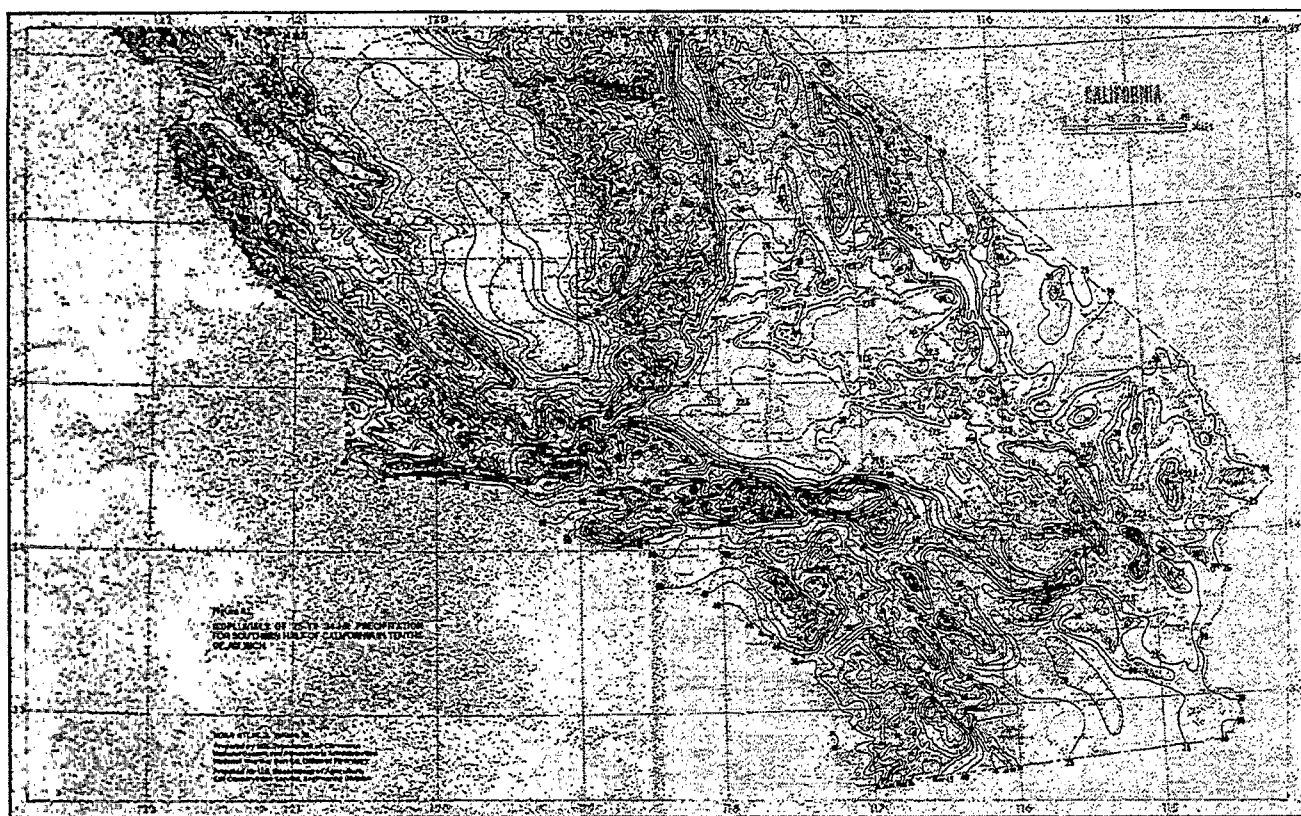
Appendix IV: Western U.S. Precipitation Frequency Maps



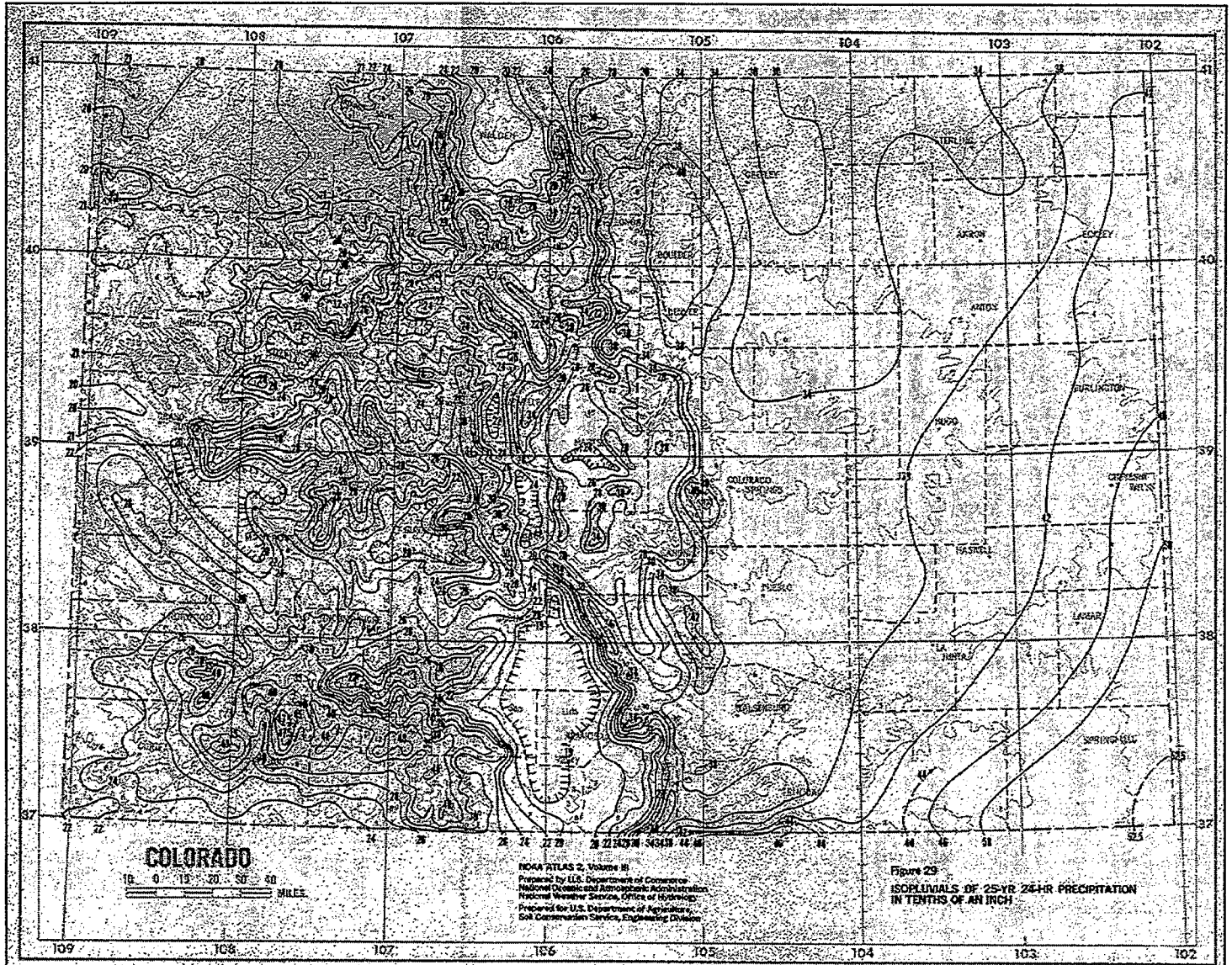
Appendix IV: Western U.S. Precipitation Frequency Maps



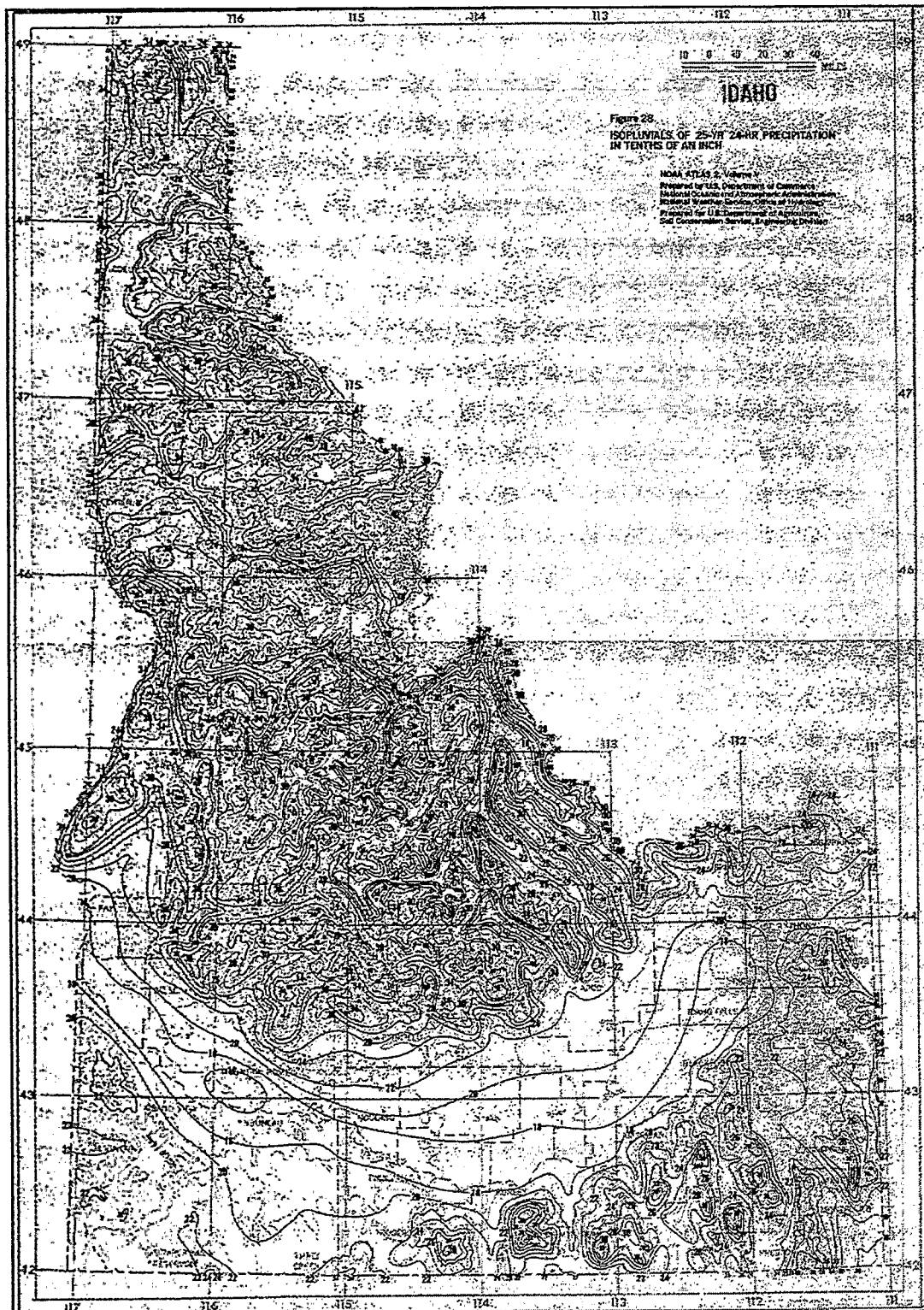
Appendix IV: Western U.S. Precipitation Frequency Maps



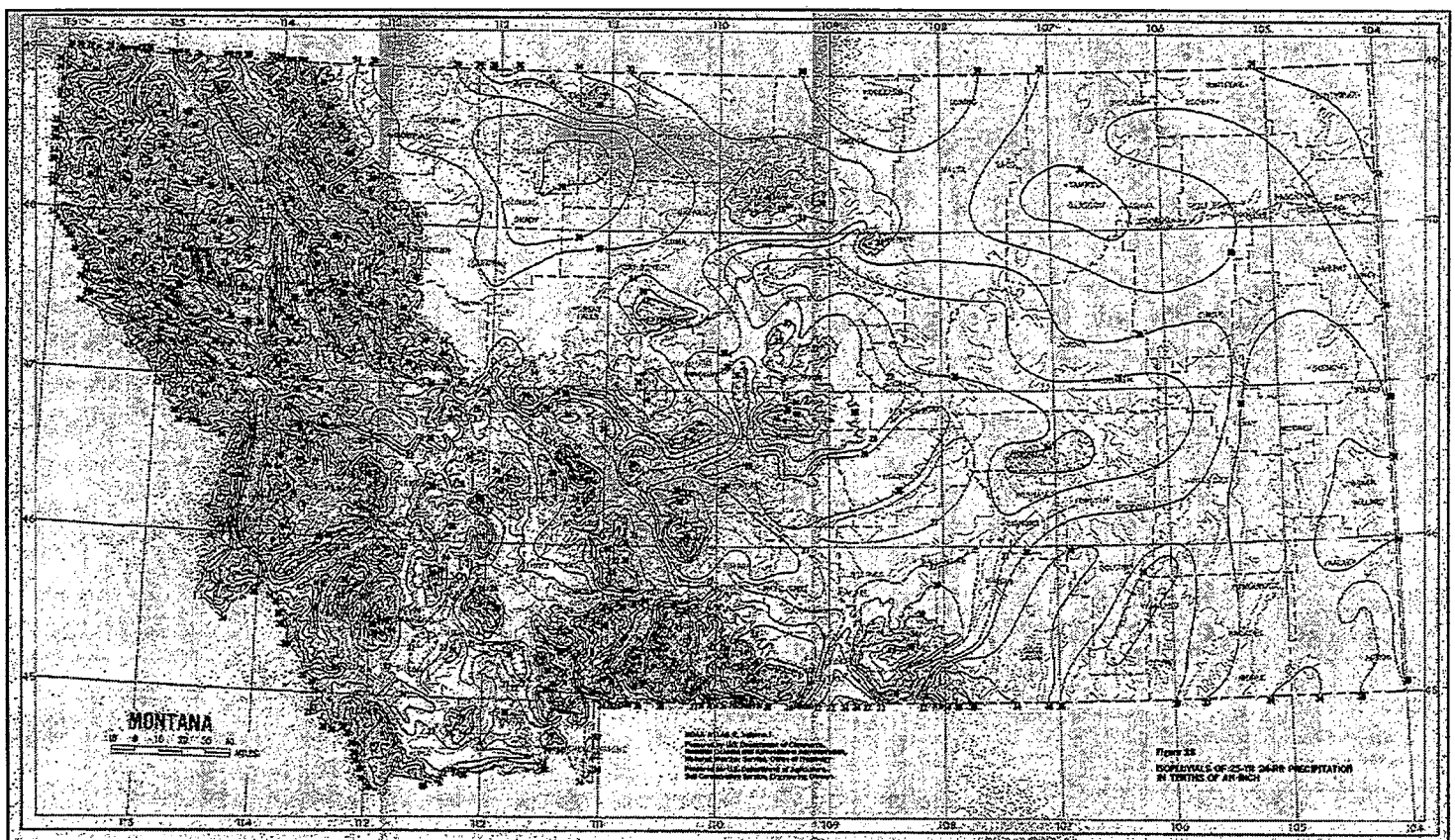
Appendix IV: Western U.S. Precipitation Frequency Maps



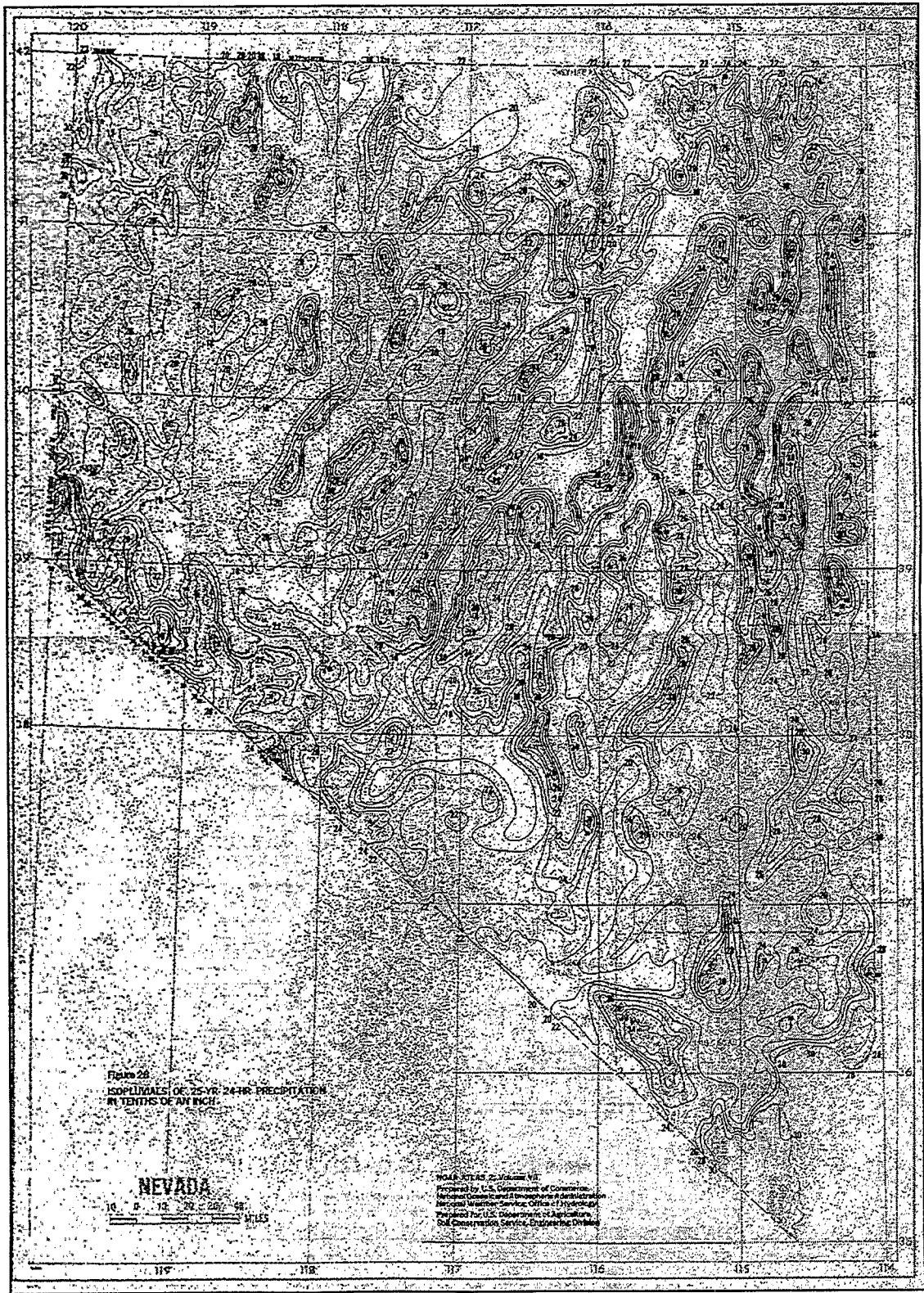
Appendix IV: Western U.S. Precipitation Frequency Maps



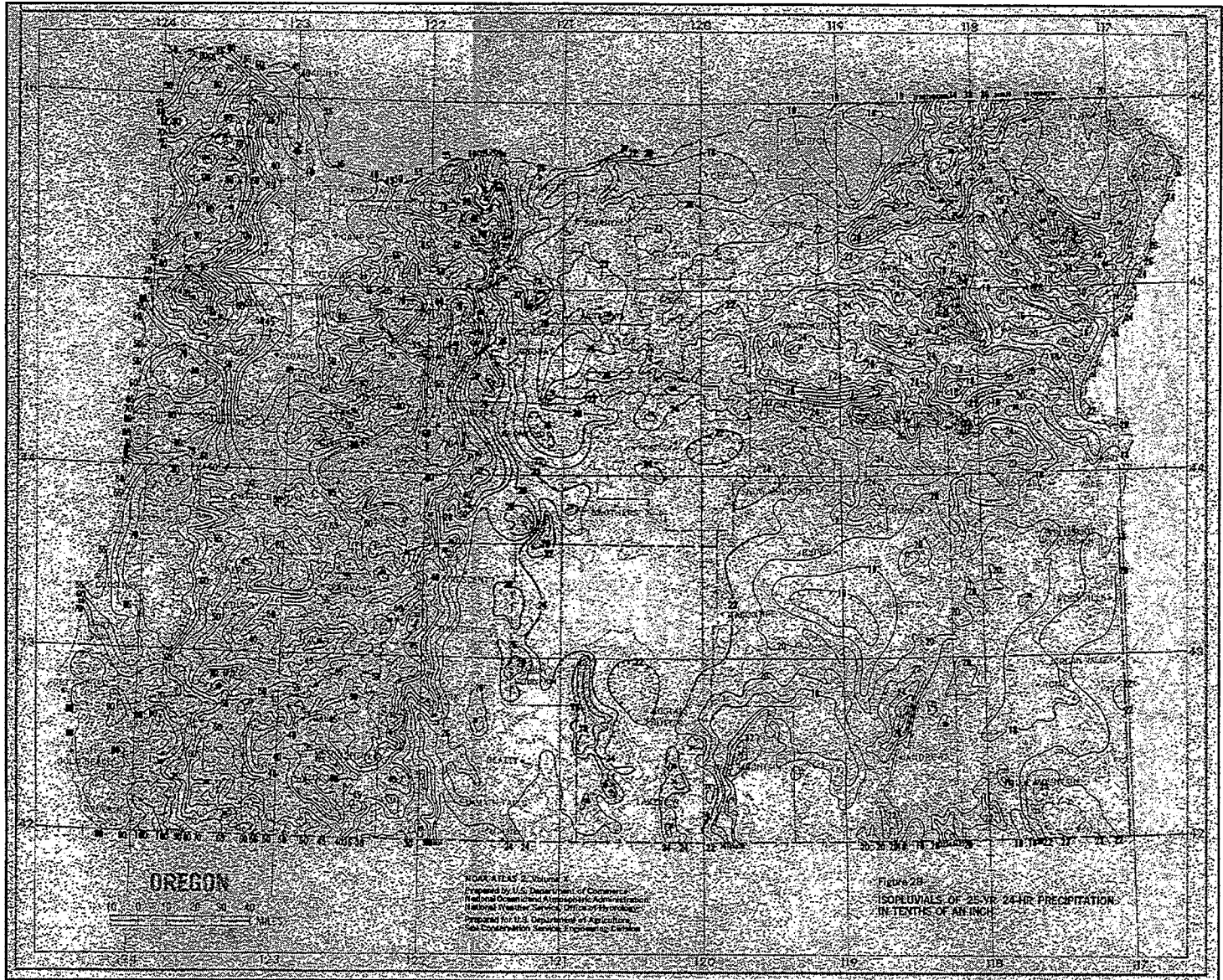
Appendix IV: Western U.S. Precipitation Frequency Maps



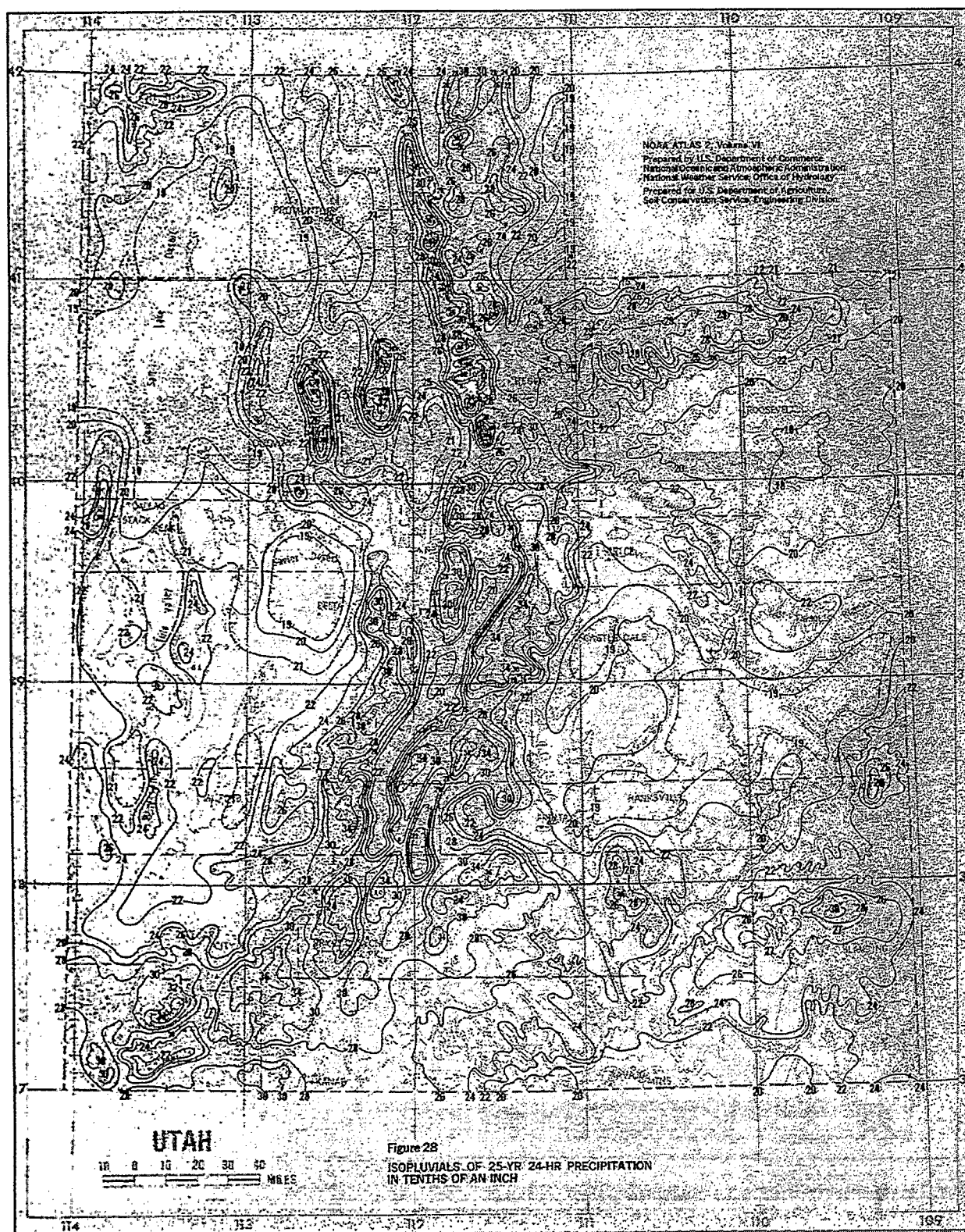
Appendix IV: Western U.S. Precipitation Frequency Maps



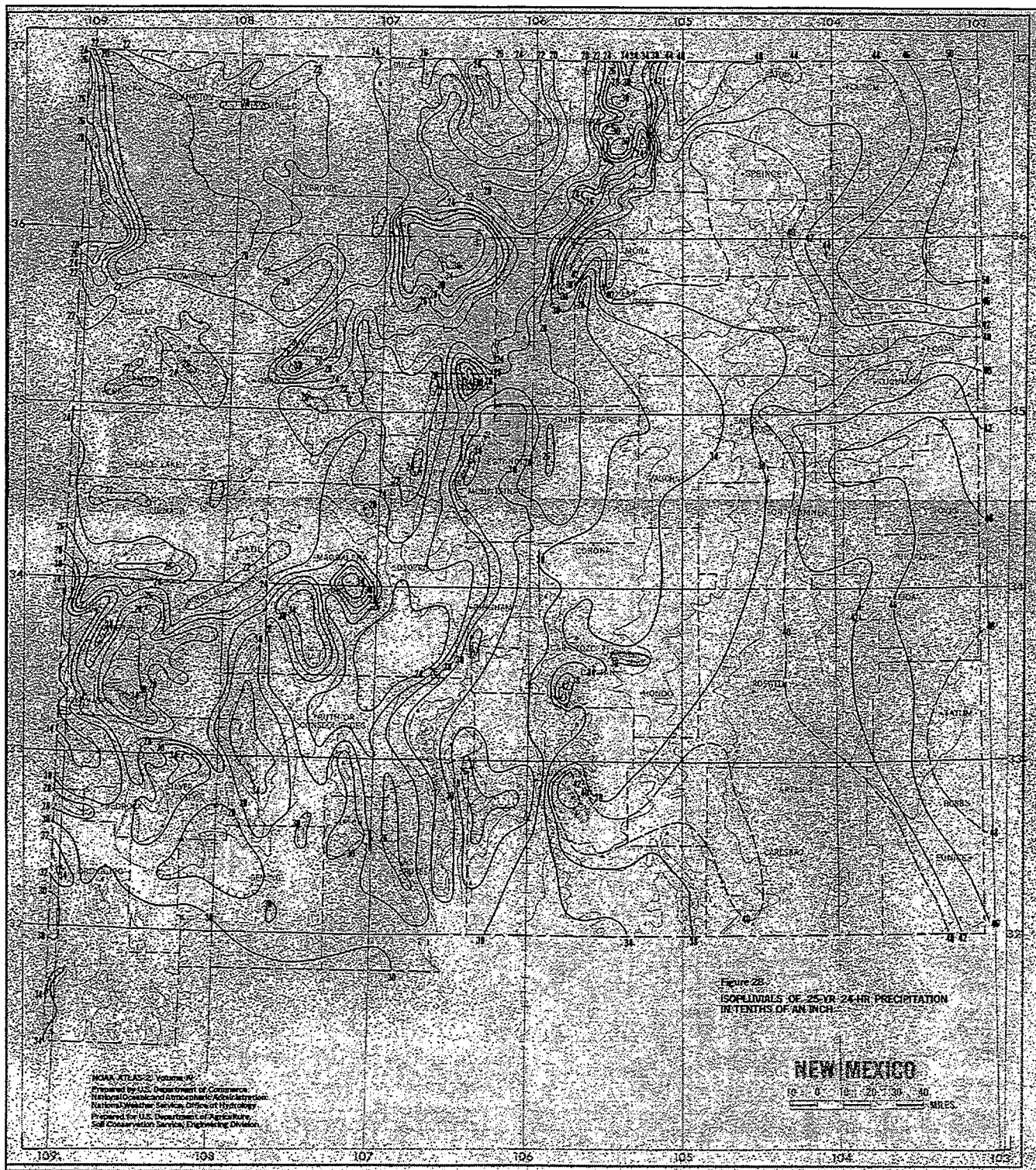
Appendix IV: Western U.S. Precipitation Frequency Maps



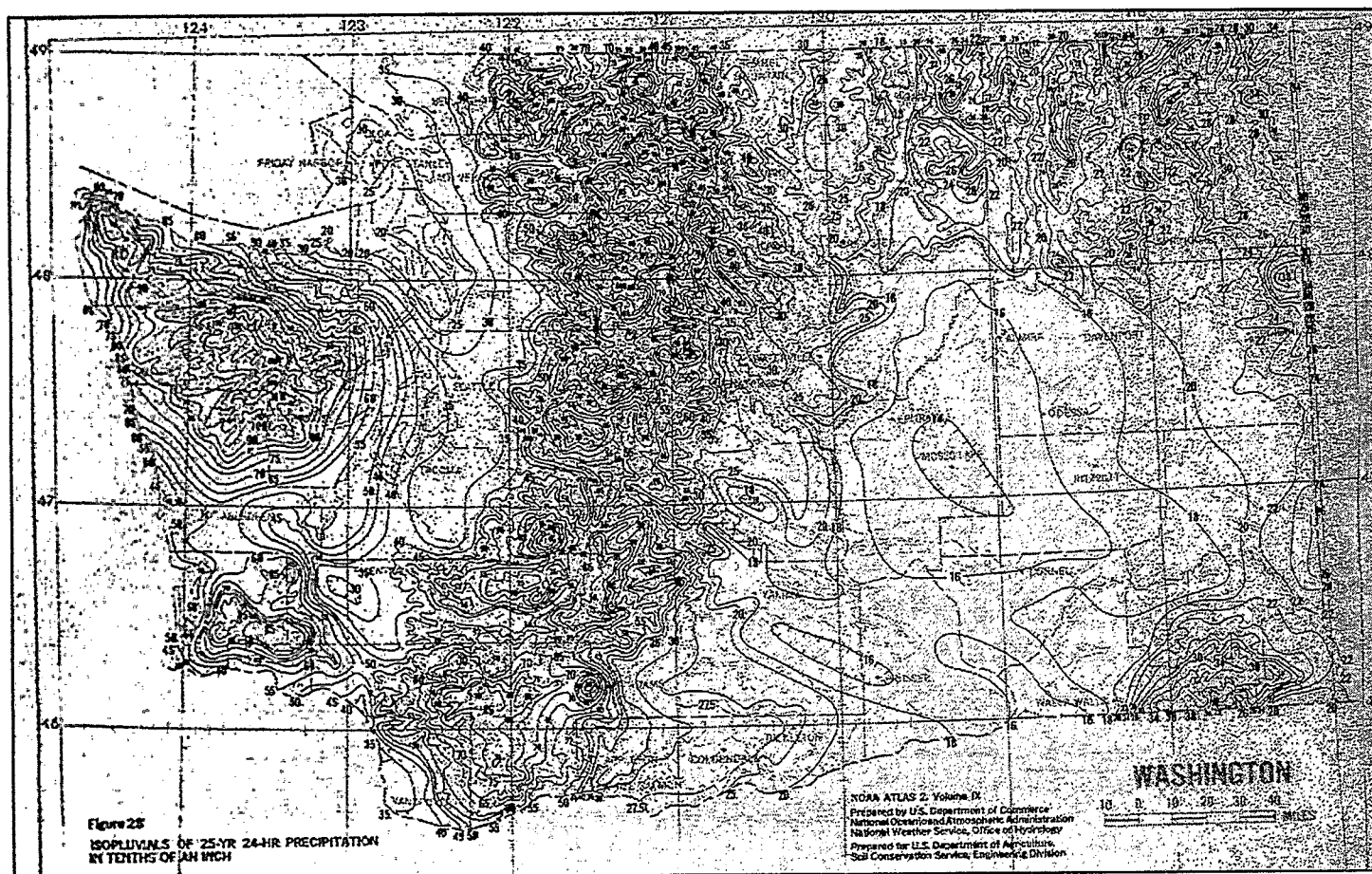
Appendix IV: Western U.S. Precipitation Frequency Maps



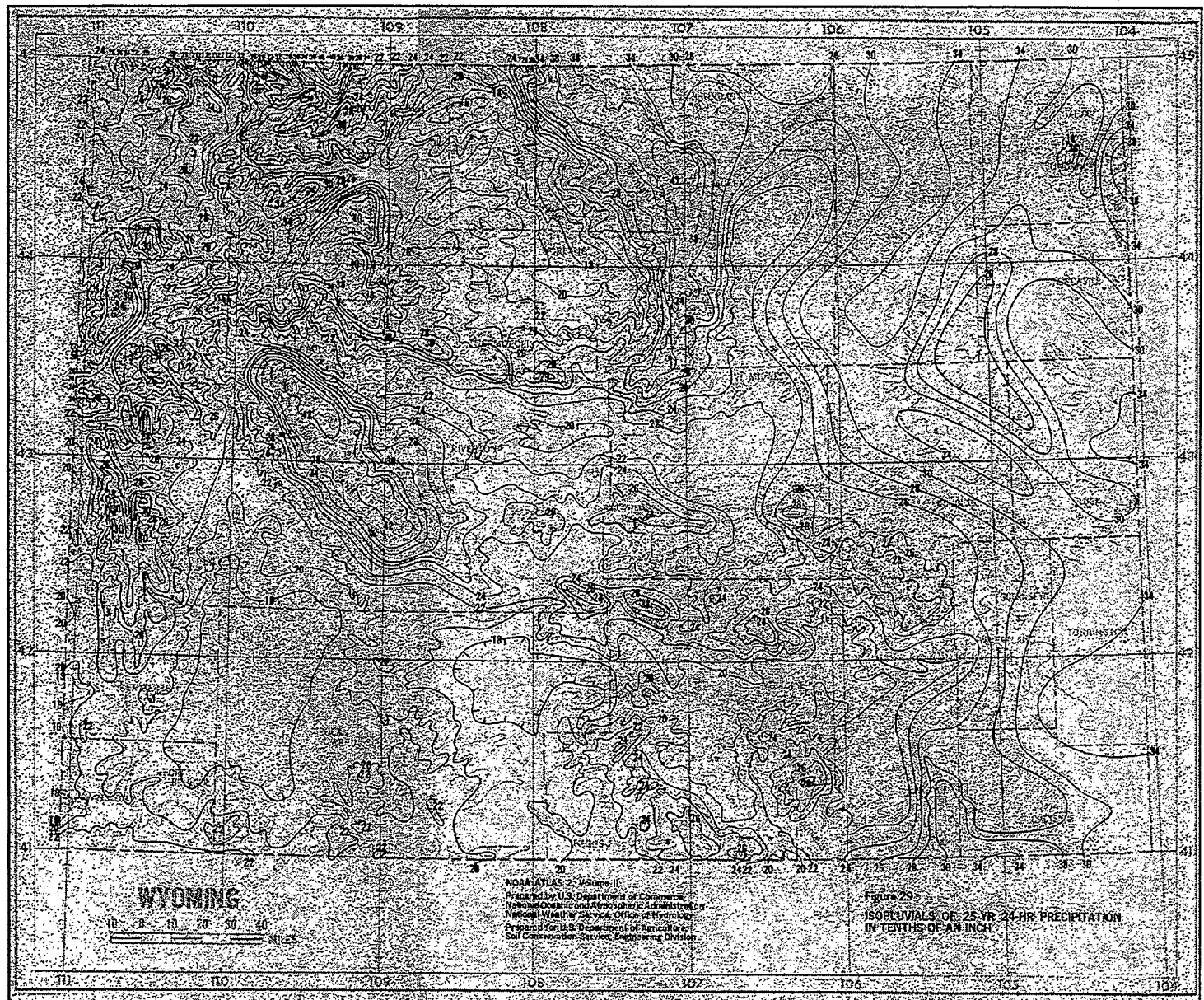
Appendix IV: Publications, Online Resources, and Software

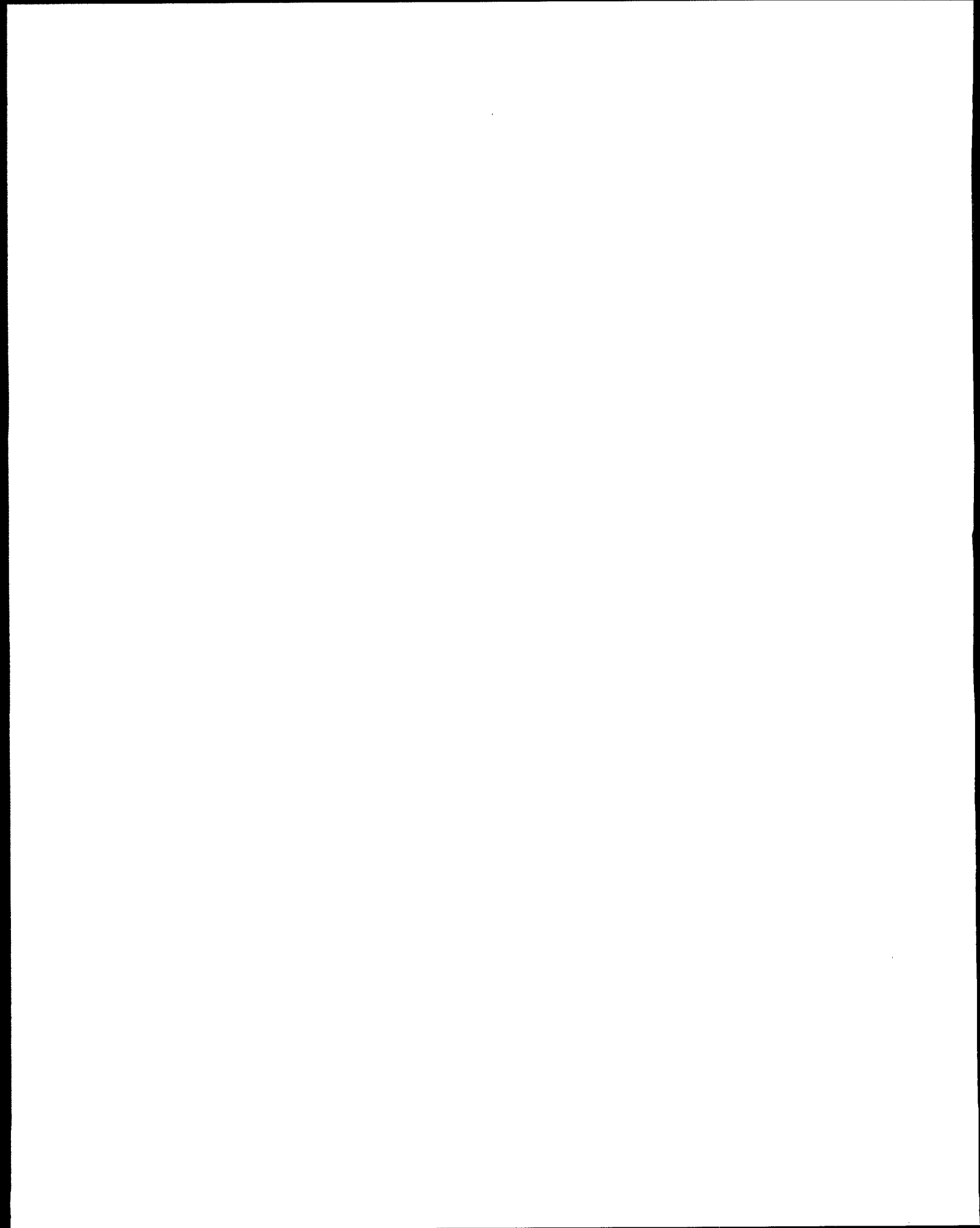


Appendix IV: Western U.S. Precipitation Frequency Maps



Appendix IV: Western U.S. Precipitation Frequency Maps





ASSESSING RISKS
APPENDICES

Guide for Industrial Waste Management Groundwater Pathway Leachate Concentration Threshold Value (LCTV) Tables

*Note: These modeling results are in draft form and are not intended to be used in current waste management decision-making. All aspects of the model are undergoing peer review and public comment, including: 1) the appropriateness of the Tier 2 model for a location-adjusted analysis; 2) input values for sensitive parameters and liner scenarios; 3) capabilities and user-friendliness of the model software. We strongly encourage users to review the chapter titled *Protecting Groundwater, Section 1: Characterizing Risk* in the EPA's **Guide for Industrial Waste Management** for a description of the model and a discussion of key parameters and some critical issues that affect modeling results.*

Explanation of Values in the LCTV Tables

The LCTV is the maximum acceptable concentration in a waste leachate and is based on a toxicity reference level (TRL) (also called a human health benchmark) such as a Maximum Contaminant Level (MCL) or a Health-Based Number (HBN). The LCTV is calculated as follows:

$$\text{LCTV} = \text{MCL (or HBN)} \times \text{DAF.}$$

The DAF (Dilution-Attenuation Factor) reflects the extent to which the waste constituent concentration is reduced between the waste management unit (WMU) and a ground-water monitoring well. The reduction in concentration that occurs in the subsurface after the leachate exits from the base of the unit can be caused by many processes, including dilution, dispersion, sorption, chemical decay, and biological decay. The DAF is determined with the EPA's Composite Model for Leachate Migration with Transformation Products (EPACMTP) (version 1.2).

Computing DAFs for all of the organic chemicals would require a large number of simulations to individually evaluate each of the combinations of retardation coefficient (R) and first-order decay rate (λ). Therefore, rather than performing EPACMTP simulations for all combinations of R and λ , the DAFs for organics were produced using a time-saving linear interpolation scheme which was based on a series of EPACMTP model runs using a range of R and λ values. This interpolation scheme was tested and verified against actual EPACMTP simulations.

The LCTVs for metals were produced by individually modeling each metal. The following metals are modeled with a non-linear adsorption isotherm generated with the MINTEQA2 geochemical model: barium, beryllium, cadmium, chromium (III), copper, lead, nickel, silver, and vanadium. Because of the non-linear nature of the adsorption isotherms for these metals, the DAF is a function of the leachate concentration and is not listed here. The following metals are modeled with a linear adsorption isotherm (an empirical relationship that predicts K_d as a function of pH) developed by Loux et al. (1990): antimony, arsenic, chromium (VI), mercury, selenium, and thallium. Mercury is modeled with a linearized version of the adsorption isotherm generated with the MINTEQA2 geochemical model. For more information about metals modeling with

EPACMTP, please see the *EPACMTP Background Document for Metals*, U.S. EPA, Office of Solid Waste, 1996.

How to Use the LCTV Tables

The LCTVs are presented in these tables for three different liner scenarios: the no liner, single liner, and composite liner (the land application unit scenario considers only the no-liner case). To use these tables:

- You first need to determine (in conjunction with your state regulatory agency) if the LCTV for each waste constituent of concern should be based on that constituent's MCL or HBN value.
- Then for each waste constituent, compare the expected leachate concentration to the three LCTVs.
- If the leachate concentration is less than the no liner LCTV, then no liner is needed to be protective of ground water.
- If the leachate concentration is greater than the no liner LCTV but less than the single liner LCTV, then a single liner is needed to be protective of ground water.
- If the leachate concentration is greater than the single liner LCTV but less than the composite liner LCTV, then a composite liner is needed to be protective of ground water.
- If any expected leachate concentrations exceed the maximum concentrations recommended for a composite liner system, consider pollution prevention, treatment, and more protective liner designs, as well as consultation among regulators, the public and industry to ensure that such wastes are protectively managed.

We invite you to provide us with any such examples where the expected leachate concentrations exceed the composite liner LCTV, so that we can ensure that the final guidance is designed to provide protective recommendations to accommodate all realistic waste management scenarios.

Exceptions to the LCTV Calculations

Usually, the LCTV reported in the table for a constituent is calculated by multiplying the reported DAF times the appropriate constituent-specific health benchmark. However, for some constituents, the DAFs obtained from the modeling are not used to calculate the LCTVs because several types of upper concentration limits, or caps, are placed on the LCTV. The LCTV may be capped at a lower value due to: 1) the TC Rule Exit Level, 2) degradation to a toxic daughter product, or 3) an overall cap of 1,000 mg/L.

- **Toxicity Characteristic (TC) Rule:** For any constituent covered by the TC rule, the LCTV is capped at the TC Rule Exit Level. The TC Rule exit level concentration (in mg/L) is given in the "Common Name" column as (TC = x).
- **Toxic Daughter Products:** For any constituent that degrades to form a toxic daughter product, the LCTV of the parent constituent has been capped at the LCTV of the toxic daughter product. If the daughter constituent has an MCL but the parent constituent does not, the MCL of the daughter product was used in calculating that LCTV. For constituents with toxic daughter products, the daughter product is noted in parenthesis in the "Common Name" column.
- **LCTV Maximum Value:** The maximum LCTV is 1,000 mg/L because contaminant leachate concentrations for these units are not expected to exceed 1,000 mg/L. Additionally, the waste could potentially be classified as hazardous at this concentration. However, we invite you to comment on the use of the 1,000 mg/L cap and whether it accommodates all realistic waste management scenarios.

For these three cases, you can't use the DAF presented in the table to calculate the reported LCTV. However, all DAFs computed for each organic waste constituent are provided in the table, regardless of the method by which the LCTV is determined. For example, for constituents that hydrolyze to produce a toxic daughter product, the DAF of the parent constituent is presented in the table, even if the LCTV has been set to that of the toxic daughter constituent.

In cases where the concentration of the constituent at the well was exceedingly low (approaching zero), no DAF is given. Instead, it is denoted in the tables with an asterisk. The LCTV is then assigned on the basis of the criteria given above: the TC Rule level, the LCTV for the daughter product, or the 1000 mg/L maximum. The criteria are denoted on the tables as follows:

- D – LCTV capped at daughter chemical LCTV;
- L – LCTV capped at 1000 mg/L;
- T – LCTV capped at TC Rule level.

Data Sources

Source for R and λ values: *EPACMTP Background Document for Finite Source Methodology*, US EPA, Office of Solid Waste, 1996. The R and λ values for all constituents listed in the LCTV tables come from this source, with the following exceptions: 1) Beta-HCH is assumed to have a λ value of 0.0 due to the lack of reliable data; and 2) Ethylene thiourea and Phenyl mercuric acetate are assumed to have an R value of 1.0 and a λ value of 0.0 due to the lack of reliable data.

Source for HBNs: *Hazardous Waste Identification Rule (HWIR) Background Document for Groundwater Pathway Results*, US EPA, Office of Solid Waste, August, 1995 (document contained in Docket # F-95-WHWP-FFFFF). The HBN represents the maximum allowable concentration in drinking water, given a defined carcinogenic risk or noncarcinogenic hazard quotient, and is calculated by the Equations 1 and 2, below:

For carcinogens:

$$C_{dw} = \frac{R \cdot BW \cdot AT \cdot 365 \frac{\text{day}}{\text{yr}}}{CR \cdot ED \cdot EF \cdot CSF_{oral}} \quad (1)$$

where

C_{dw}	=	maximum allowable aqueous water concentration in drinking water (mg/L)
R	=	risk for individual chemical (1×10^{-6} [unitless])
BW	=	body weight (70 kilograms)
AT	=	averaging time (70 years)
CR	=	water consumption rate (2.0 L/day)
ED	=	exposure duration (30 years)
EF	=	exposure frequency (350 day/yr)
CSF_{oral}	=	chemical-specific oral cancer slope factor (mg/kg/day) ⁻¹

For noncarcinogens:

$$C_{dw} = \frac{THQ \cdot RfD_{oral} \cdot BW \cdot AT \cdot 365 \frac{day}{yr}}{CR \cdot EF \cdot ED} \quad (2)$$

where

C_{dw}	=	maximum allowable aqueous water concentration in drinking water (mg/L)
THQ	=	target hazard quotient (1.0 [unitless])
RfD_{oral}	=	chemical-specific oral reference dose (mg/kg/day)
BW	=	body weight (70 kilograms)
AT	=	averaging time (30 years)
CR	=	water consumption rate (2.0 L/day)
EF	=	exposure frequency (350 day/yr)
ED	=	exposure duration (30 years)

Source for MCLs: *Drinking Water Regulations and Health Advisories*, US EPA, Office of Water, October, 1996 (EPA 822-B-96-002). National Primary Drinking Water Regulations are also available at the following web site: <http://www.epa.gov/OGWDW/wot/appa.html>

Abbreviations and Symbols

LCTV = Leachate Concentration Threshold Value (LCTV = MCL (or HBN) x DAF)

CAS# = Chemical Abstract Service Registry Number

C? = Is the constituent a carcinogen?

C = Carcinogen

NC = Non-carcinogen

R = Retardation Factor (Retardation is the degree to which a waste constituent moves more slowly through the aquifer than the groundwater in which it is transported. Retardation results from sorption processes by which a solute clings to a solid surface.)

λ = First Order Decay Rate (Decay processes include chemical hydrolysis and biodegradation. However, in the modeling for these Tier 1 LCTV tables only chemical hydrolysis is considered, since biodegradation rates can vary widely from one site to another. Chemical hydrolysis is the breaking down of molecules by the addition of water. The products of hydrolysis consist of less complex molecules and usually include an alcohol or carboxylic acid.)

NA = Not Applicable

HBN = Health-Based Number

MCL = Maximum Contaminant Level

D = LCTV Capped at daughter chemical LCTV

L = LCTV Capped at 1000 mg/L

T = LCTV capped at TC Rule level.

Modeling Assumptions

- Well location = 150 m down gradient on plume centerline
- All EPACMTP input parameters that are not specified here are set to the default value or distribution described in *Technical Background Document: Industrial Waste Management Evaluation Model (IWEM)*, *Ground Water Model to Support the Guide for Industrial Waste Management*, US EPA, Office of Solid Waste, 1998 and *EPA's Composite Model for Leachate Migration with Transformation Products (EPACMTP): User's Guide*, US EPA, Office of Solid Waste, 1997.

Landfill

- Infiltration Rates

No Liner = Regional, site-based Monte Carlo distribution (from HELP modeling based on OSW Survey data) (min = 1.0×10^{-5} m/yr, median = 0.13 m/yr, max = 1.08 m/yr)

Single Liner = Regional, site-based Monte Carlo distribution from HELP modeling of 25 representative climate stations (min = 1.0×10^{-5} m/yr, median = 0.043 m/yr, max = 0.053 m/yr)

Composite Liner = 3.4×10^{-5} m/yr

- Waste fraction = 1.0
- For the landfill scenario, a retardation coefficient of 1 was used in the interpolation of DAFs for all organics because the long source duration for the landfill scenario produces steady-state conditions. Thus, higher retardation coefficients delay the time at which the peak concentration arrives at the well, but do not change the magnitude of the peak well concentration.

Surface Impoundment

- Infiltration Assumptions:

No Liner/In-Situ Soil: 2 foot thick native soil/sludge layer with a range of hydraulic conductivity values from 1×10^{-7} to 1×10^{-5} cm/sec

Single Liner: 3 foot thick clay liner with a hydraulic conductivity of 1×10^{-7} cm/sec

Composite Liner: 3 foot thick clay liner under a 40 mil HDPE FML geomembrane

- Infiltration Rates (derived by EPACMTP based on impoundment characteristics, including ponding depth which is based on OSW Survey data):

No Liner = Regional, site-based Monte Carlo distribution (min = 1.83×10^{-2} m/yr, median = 3.94 m/yr, max = 89.6 m/yr)

Single Liner = Regional, site-based Monte Carlo distribution (min = 6.8×10^{-3} m/yr, median = 0.13 m/yr, max = 1.46 m/yr)

Composite Liner = 3.1×10^{-4} m/yr

Waste Pile

- Infiltration Rates

No Liner = Regional, site-based Monte Carlo distribution (from HELP modeling based on OSW Survey data) (min = 2.54×10^{-5} m/yr, median = 0.265 m/yr, max = 1.21 m/yr)

Single Liner = Regional, site-based Monte Carlo distribution from HELP modeling of 25 representative climate stations (min = 1.0×10^{-5} m/yr, median = 0.126 m/yr, max = 0.135 m/yr)

Composite Liner = 3.4×10^{-5} m/yr

Land Application Unit

The methodology for the modeling of land application units assumes that:

- 6" of sludge is applied per year over the 40-year lifetime of the facility;
- 80% of the sludge is water; and
- half of this water infiltrates to the subsurface.

Therefore, the effective infiltration rate for land application units is the regional infiltration rate (in m/yr) plus 0.4 (half of 80%) times the yearly application rate of sludge (in m/yr). This infiltration rate is used over the entire 10,000 year modeling period. The bulk density of the sludge is assumed to be 2.65 g/cm^3 and the fraction organic carbon of the sludge is assumed to be 0.3 (*Technical Support Document for the Hazardous Waste Identification Rule: Risk Assessment for Human and Ecological Receptors*, U.S. EPA, Office of Solid Waste, August, 1995). This methodology is explained more fully in the Technical Support Document for the Industrial Solid Waste Guidance Groundwater Modeling.

- Infiltration Rate:
No Liner: min = 0.061 m/yr, median = 0.182 m/yr, max = 0.806 m/yr

Draft LCTVs for Landfills

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Acenaphthene	83329	NC	16.0	0.00		2.0	2.2		4.4	4.6		9.2	4.4E+05		1000
Acetone (2-propanone)	67641	NC	1.0	0.00		4.0	2.2		8.8	4.6		18	4.4E+05		1000
Acetonitrile (methyl cyanide)	75058	NC	1.0	8.23E-07		0.20	2.2		0.44	4.6		0.92	4.5E+05		1000
Acetophenone	98862	NC	1.0	0.00		4.0	2.2		8.8	4.6		18	4.4E+05		1000
Acrolein	107028	NC	1.0	1.9E+08		0.70	*L		1000	*L		1000	*L		1000
Acrylamide	79061	C	1.0	0.0052		2.0E-05	2.9		5.8E-05	11		2.2E-04	*L		1000
Acrylonitrile (degrades to Acrylamide)	107131	C	1.0	0.00012		2.0E-04	2.2		5.8E-05	4.7		2.2E-04	4.5E+07		1000
Aldrin	309002	C	4025	0.00		5.0E-06	2.2		1.1E-05	4.5		2.3E-05	4.1E+05		2.1
Aniline (benzenamine)	62533	C	1.0	0.00		0.010	2.2		0.022	4.5		0.045	4.1E+05		1000
Benz[a]anthracene	56553	C	583	0.00		7.7E-05	2.2		1.7E-04	4.5		3.5E-04	4.1E+05		32
Benzene (TC = 0.5)	71432	C	1.2	0.00	0.0050	0.0030	2.2	0.011	0.0066	4.5	0.023	0.014	4.1E+05	0.50	0.50
Benzidine	92875	C	1.0	0.00		4.0E-07	2.2		8.8E-07	4.5		1.8E-06	4.1E+05		0.16
Benzo[a]pyrene	50328	C	1678	0.00	2.0E-04	1.0E-05	2.2	4.4E-04	2.2E-05	4.5	9.0E-04	4.5E-05	4.1E+05	82	4.1
Benzo[b]fluoranthene	205992	NC	1678	0.00		7.1E-05	2.2		1.6E-04	4.6		3.3E-04	4.4E+05		31
Benzyl alcohol	100516	NC	1.0	0.00		10	2.2		22	4.6		46	4.4E+05		1000
Benzyl chloride (degrades to Benzyl alcohol)	100447	C	2.8	119		5.0E-04	*D		22	*D		46	*L		1000
Bis(2-chloroethyl)ether (degrades to 1,4-Dioxane)	111444	C	1.0	0.067		8.0E-05	7.2		5.8E-04	140		0.011	*L		1000
Bis(2-chloroisopropyl)ether	39638329	C	1.7	0.00		0.0010	2.2		0.0022	4.5		0.0045	4.1E+05		410
Bis(2-ethylhexyl)phthalate	117817	C	35864	7.15E-10	0.0060	0.0060	2.2	0.013	0.013	4.5	0.027	0.027	4.1E+05	1000	1000
Bromodichloromethane	75274	C	1.2	0.00079	0.080	0.0014	2.3	0.18	0.0032	5.1	0.41	0.0071	1.7E+09	1000	1000
Bromomethane (degrades to Methanol)	74839	NC	1.0	2.7		0.050	1.7E+06		44	*D		92	*L		1000
Butanol	71363	NC	1.0	0.00		4.0	2.2		8.8	4.6		18	4.4E+05		1000
Butyl 4,6-dinitrophenol, 2-sec-(Dinoseb)	88857	NC	1.3	0.00	0.0070	0.040	2.2	0.015	0.088	4.6	0.032	0.18	4.4E+05	1000	1000
Butyl benzyl phthalate	85687	NC	46.1	4.76E-05		7.0	2.2		15	4.6		32	7.5E+05		1000
Carbon disulfide	75150	NC	1.2	0.00049		4.0	2.2		8.8	4.9		20	9.5E+08		1000
Carbon tetrachloride (TC = 0.5)	56235	C	1.7	0.0049	0.0050	7.0E-04	2.6	0.013	0.0018	7.7	0.039	0.0054	*T	0.50	0.50
Chlordane (TC = 0.03)	57749	C	2065	3.34E-10	0.0020	7.0E-05	2.2	0.0044	1.5E-04	4.5	0.0090	3.2E-04	4.1E+05	0.030	0.030
Chloro-1,3-butadiene 2-(Chloroprene)	126998	NC	1.1	0.00		0.70	2.2		1.5	4.6		3.2	4.4E+05		1000
Chloroaniline p-	106478	NC	1.1	0.00		0.10	2.2		0.22	4.6		0.46	4.4E+05		1000
Chlorobenzene (TC = 100)	108907	NC	2.0	0.00	0.10	0.70	2.2	0.22	1.5	4.6	0.46	3.2	4.4E+05	100	100
Chlorobenzilate	510156	C	30.2	0.0017		3.0E-04	2.3		6.9E-04	5.7		0.0017	*L		1000
Chlorodibromomethane	124481	C	1.2	0.00038	0.080	0.0010	2.2	0.18	0.0022	4.9	0.39	0.0049	6.8E+08	1000	1000
Chloroform (TC = 6.0)	67663	C	1.1	7.46E-05	0.080	0.010	2.2	0.18	0.022	4.6	0.37	0.046	1.1E+06	6.0	6.0
Chloromethane	74873	C	1.0	0.00		6.6E-03	2.2		0.015	4.5		0.030	4.1E+05		1000
Chlorophenol 2-	95578	NC	1.2	0.00		0.20	2.2		0.44	4.6		0.92	4.4E+05		1000
Chloropropene, 3- (Allyl Chloride)	107051	NC	1.0	12		1.75	*L		1000	*L		1000	*L		1000
Chrysene	218019	NC	583	0.00		0.0027	2.2		0.0059	4.6		0.012	4.4E+05		1000
Cresol m- (TC = 200)	108394	NC	1.2	0.00		2.0	2.2		4.4	4.6		9.2	4.4E+05		200
Cresol o- (TC = 200)	95487	NC	1.2	0.00		2.0	2.2		4.4	4.6		9.2	4.4E+05		200
Cresol p- (TC = 200)	106445	NC	1.2	0.00		0.20	2.2		0.44	4.6		0.92	4.4E+05		200
Cumene	98828	NC	7.7	0.00		1.0	2.2		2.2	4.6		4.6	4.4E+05		1000
DDD	72548	C	2065	0.0073		4.0E-04	2.9		0.0012	11		0.0044	*L		1000
DDE	72559	C	11606	0.00		3.0E-04	2.2		6.6E-04	4.5		0.0014	4.1E+05		123
DDT, p,p'- (degrades to DDE)	50293	C	10344	0.017		3.0E-04	3.6		6.6E-04	32		0.0014	*D		123
Di-n-butyl phthalate	84742	NC	63.3	3.47E-05		4.0	2.2		8.8	4.6		18	6.7E+05		1000

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							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Di-n-octyl phthalate	117840	NC	105841	8.99E-08		0.70	2.2		1.5	4.6		3.2	4.4E+05		1000
Diallylate	2303164	C	40.3	0.029		0.0010	4.3		0.0043	53		0.053	*L		1000
Dibenz[a,h]anthracene	53703	C	8804	0.00		1.1E-05	2.2		2.4E-05	4.5		5.0E-05	4.1E+05		4.5
Dibromo-3-chloropropane 1,2-	96128	C	1.2	0.0029	2.0E-04	6.0E-05	2.4	4.8E-04	1.4E-04	6.5	0.0013	3.9E-04	*L	1000	1000
Dichlorobenzene 1,2-	95501	NC	4.2	0.00	0.60	3.0	2.2	1.3	6.6	4.6	2.8	14	4.4E+05	1000	1000
Dichlorobenzene 1,4- (TC = 7.5)	106467	C	4.0	0.00	0.075	0.0040	2.2	0.17	0.0088	4.5	0.34	0.018	4.1E+05	7.5	7.5
Dichlorobenzidine 3,3'-	91941	C	6.6	0.00		2.0E-04	2.2		4.4E-04	4.5		9.0E-04	4.1E+05		82
Dichlorodifluoromethane (Freon 12)	75718	NC	1.4	0.00		7.0	2.2		15	4.6		32	4.4E+05		1000
Dichloroethane 1,1- (degrades to Vinyl chloride)	75343	C	1.1	0.0033		9.0E-04	2.5	0.0044	8.8E-05	6.7	0.0092	1.8E-04	*D	0.20	0.20
Dichlorophenol 2,4-	120832	NC	1.8	0.00		0.10	2.2		0.22	4.6		0.46	4.4E+05		1000
Dichlorophenoxyacetic acid 2,4-(2,4-D) (TC = 10)	94757	NC	1.0	0.00		0.40	2.2		0.88	4.6		1.8	4.4E+05		10
Dichloropropane 1,2-	78875	C	1.1	0.013	0.0050	0.0010	2.9	0.015	0.0029	11	0.055	0.011	*L	1000	1000
Dichloropropene 1,3-(mixture of isomers)	542756	C	1.1	0.00		5.0E-04	2.2		0.0011	4.5		0.0023	4.1E+05		205
Dichloropropene cis-1,3-	10061015	C	1.2	12		5.0E-04	*L		1000	*L		1000	*L		1000
Dichloropropene trans-1,3-	10061026	C	1.2	12		5.0E-04	*L		1000	*L		1000	*L		1000
Dieldrin	60571	C	321	0.018		5.0E-06	3.6		1.8E-05	32		1.6E-04	*L		1000
Diethyl phthalate	84662	NC	1.3	0.0045		30	2.5		75	7.5		225	*L		1000
Diethylstilbestrol	56531	C	33.7	0.00		2.0E-08	2.2		4.4E-08	4.5		9.0E-08	4.1E+05		0.0082
Dimethoate (degrades to Methanol)	60515	NC	1.0	0.57		0.0070	310		2.2	7.0E+05		92	*L		1000
Dimethoxybenzidine 3,3'-	119904	C	1.1	0.00		0.0060	2.2		0.013	4.5		0.027	4.1E+05		1000
Dimethyl phthalate (degrades to Methanol)	131113	NC	1.0	0.032		400	4.3		44	53		92	*L		1000
Dimethylbenz[a]anthracene 7,12-	57976	NC	11606	0.00		3.0E-06	2.2		6.6E-06	4.6		1.4E-05	4.4E+05		1.3
Dimethylbenzidine 3,3'-	119937	C	1.9	0.00		9.0E-06	2.2		2.0E-05	4.5		4.1E-05	4.1E+05		3.7
Dimethylphenol 2,4-	105679	NC	1.5	0.00		0.70	2.2		1.5	4.6		3.2	4.4E+05		1000
Dinitrobenzene 1,3-	99650	NC	1.1	0.00		0.0040	2.2		0.0088	4.6		0.018	4.4E+05		1000
Dinitrophenol 2,4-	51285	NC	1.0	0.00		0.070	2.2		0.15	4.6		0.32	4.4E+05		1000
Dinitrotoluene 2,4- (TC = 0.13)	121142	NC	1.1	0.00		0.070	2.2		0.13	4.6		0.13	4.4E+05		0.13
Dinitrotoluene 2,6-	606202	NC	1.1	0.00		0.040	2.2		0.088	4.6		0.18	4.4E+05		1000
Dioxane 1,4-	123911	C	1.0	0.00		0.0080	2.2		0.018	4.5		0.036	4.1E+05		1000
Diphenylamine	122394	NC	6.3	0.00		0.90	2.2		2.0	4.6		4.1	4.4E+05		1000
Disulfoton	298044	NC	3.3	0.67		0.0010	710		0.71	2.2E+07		1000	*L		1000
Endosulfan (Endosulfan I and II, mixture)	115297	NC	10.4	0.64		0.20	550		110	1.3E+07		1000	*L		1000
Endrin (TC = 0.02)	72208	NC	107	0.016	0.0020	0.010	3.6	0.0072	0.020	32	0.020	0.020	*T	0.020	0.020
Epichlorohydrin	106898	C	1.0	9.0		0.0090	*L		1000	*L		1000	*L		1000
Ethoxyethanol 2-	110805	NC	1.0	0.00		10	2.2		22	4.6		46	4.4E+05		1000
Ethyl acetate	141786	NC	1.0	0.063		30	6.5		195	120		1000	*L		1000
Ethyl ether	60297	NC	1.0	0.00		7.0	2.2		15	4.6		32	4.4E+05		1000
Ethyl methacrylate	97632	NC	1.0	0.019		3.0	3.6		11	32		96	*L		1000
Ethyl methanesulfonate	62500	C	1.0	363		3.0E-07	*L		1000	*L		1000	*L		1000
Ethylbenzene	100414	NC	3.7	0.00	0.70	4.0	2.2	1.5	8.8	4.6	3.2	18	4.4E+05	1000	1000
Ethylene dibromide (1,2-Dibromoethane)	106934	C	1.1	0.18	5.0E-05	1.0E-06	21	0.0011	2.1E-05	1300	0.065	0.0013	*L	1000	1000
Ethylene thiourea	96457	C	1	0.0000		2.0E-05	2.2		4.5E-05	4.5		9.2E-05	4.1E+05		8.4
Fluoranthene	206440	NC	114	0.00		1.0	2.2		2.2	4.6		4.6	4.4E+05		1000
Fluorene	86737	NC	22.6	0.00		1.0	2.2		2.2	4.6		4.6	4.4E+05		1000
Formaldehyde	50000	NC	1.0	0.00		7.0	2.2		15	4.6		32	4.4E+05		1000
Formic acid	64186	NC	1.0	0.00		70	2.2		154	4.6		322	4.4E+05		1000
Furan	110009	NC	1.0	0.00		0.040	2.2		0.088	4.6		0.18	4.4E+05		1000

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HCH beta-	319857	C	8.2	0.00		5.0E-05	2.2		1.1E-04	4.5		2.3E-04	4.1E+05		21
HCH (Lindane) gamma- (TC = 0.4) (degrades to 1,2,4-Trichlorobenzene)	58899	C	7.7	0.31	2.0E-04	7.0E-05	110	0.022	0.0077	2.1E+05	0.32	0.40	*T	0.40	0.40
HCH alpha- (degrades to 1,2,4-Trichlorobenzene)	319846	C	8.2	0.31		1.0E-05	110	0.15	0.0011	2.1E+05	0.32	1.8	*L	1000	1000
Heptachlor (TC = 0.008)	76448	C	432	18	4.0E-04	2.0E-05	*T	0.0080	0.0080	*T	0.0080	0.0080	*T	0.0080	0.0080
Heptachlor epoxide	1024573	C	212	0.018	2.0E-04	9.0E-06	3.6	7.2E-04	3.2E-05	32	0.0064	2.9E-04	*L	1000	1000
Hexachloro-1,3-butadiene (TC = 0.5)	87683	C	77.7	0.00		0.0010	2.2		0.0022	4.5		0.0045	4.1E+05		0.50
Hexachlorobenzene (TC = 0.13)	118741	C	686	0.00	0.0010	5.0E-05	2.2	0.0022	1.1E-04	4.5	0.0045	2.3E-04	4.1E+05	0.13	0.13
Hexachlorocyclopentadiene	77474	NC	141	7.2	0.050	0.30	*L	1000	1000	*L	1000	1000	*L	1000	1000
Hexachloroethane (TC = 3.0)	67721	C	11.8	0.00		0.0060	2.2		0.013	4.5		0.027	4.1E+05		3.0
Hexachlorophene	70304	NC	267	0.00		0.010	2.2		0.022	4.6		0.046	4.4E+05		1000
Indeno[1,2,3-cd]pyrene	193395	C	4839	0.00		2.1E-04	2.2		4.6E-04	4.5		9.5E-04	4.1E+05		86
Isobutyl alcohol	78831	NC	1.0	0.00		10	2.2		22	4.6		46	4.4E+05		1000
Isophorone	78591	C	1.2	0.00		0.090	2.2		0.20	4.5		0.41	4.1E+05		1000
Kepone	143500	C	38.6	0.00		2.0E-06	2.2		4.4E-06	4.5		9.0E-06	4.1E+05		0.82
Methacrylonitrile	126987	NC	1.0	0.00012		0.0040	2.2		0.0088	4.7		0.019	4.8E+07		1000
Methanol	67561	NC	1.0	0.00		20	2.2		44	4.6		92	4.4E+05		1000
Methyl parathion (degrades to Methanol)	298000	NC	1.8	0.81		0.0090	1500		14	6.3E+07		92	*L		1000
Methylcholanthrene 3-	56495	C	26587	0.00		3.0E-06	2.2		6.6E-06	4.5		1.4E-05	4.1E+05		1.2
Methylene bromide (Dibromomethane)	74953	NC	1.0	0.00		0.40	2.2		0.88	4.6		1.8	4.4E+05		1000
Methylene Chloride (Dichloromethane) (degrades to Formaldehyde)	75092	C	1.0	0.00029	0.0050	0.010	2.2	0.011	0.022	4.8	0.024	0.048	4.7E+08	1000	1000
N-Nitroso-di-n-butylamine	924163	C	1.3	0.00		2.0E-05	2.2		4.4E-05	4.5		9.0E-05	4.1E+05		8.2
N-Nitroso-di-n-propylamine	621647	C	1.0	0.00		1.0E-05	2.2		2.2E-05	4.5		4.5E-05	4.1E+05		4.1
N-Nitrosodiethylamine	55185	C	1.0	0.00		6.0E-07	2.2		1.3E-06	4.5		2.7E-06	4.1E+05		0.25
N-Nitrosodimethylamine	62759	C	1.0	0.00		2.0E-06	2.2		4.4E-06	4.5		9.0E-06	4.1E+05		0.82
N-Nitrosodiphenylamine	86306	C	2.8	0.00		0.020	2.2		0.044	4.5		0.090	4.1E+05		1000
N-Nitrosomethylethylamine	10595956	C	1.0	0.00		4.0E-06	2.2		8.8E-06	4.5		1.8E-05	4.1E+05		1.6
N-Nitrosopiperidine	100754	C	1.0	0.00		2.0E-06	2.2		4.4E-06	4.5		9.0E-06	4.1E+05		0.82
N-Nitrosopyrrolidine	930552	C	1.0	0.00		4.0E-05	2.2		8.8E-05	4.5		1.8E-04	4.1E+05		16
Naphthalene	91203	NC	4.4	0.00		1.0	2.2		2.2	4.6		4.6	4.4E+05		1000
Nitrobenzene (TC = 2.0)	98953	NC	1.1	0.00		0.020	2.2		0.044	4.6		0.092	4.4E+05		2.0
Octamethyl pyrophosphoramide	152169	NC	1.0	8.80E-05		0.070	2.2		0.15	4.7		0.33	1.0E+06		1000
Parathion (ethyl)	56382	NC	4.8	0.71		0.20	930		186	3.4E+07		1000	*L		1000
Pentachlorobenzene	608935	NC	654	0.00		0.030	2.2		0.066	4.6		0.14	4.4E+05		1000
Pentachloronitrobenzene (PCNB)	82688	C	100	0.00		3.0E-04	2.2		6.6E-04	4.5		0.0014	4.1E+05		123
Pentachlorophenol (TC = 100)	87865	C	4.1	0.00	0.0010	7.0E-04	2.2	0.0022	0.0015	4.5	0.0045	0.0032	4.1E+05	100	100
Phenol	108952	NC	1.0	0.00		20	2.2		44	4.6		92	4.4E+05		1000
Phenyl mercuric acetate	62384	NC	1.0	0.00		0.0028	2.2		0.0062	4.6		0.013	4.4E+05		1000
Phenylenediamine, 1,3-	108452	NC	1.0	0.00		0.20	2.2		0.44	4.6		0.92	4.4E+05		1000
Phorate	298022	NC	2.2	18		0.0070	*L		1000	*L		1000	*L		1000
Polychlorinated biphenyls (Aroclors)	1336363	C	4119	0.00	5.0E-04	1.0E-05	2.2	0.0011	2.2E-05	4.5	0.0023	4.5E-05	4.1E+05	205	4.1
Pronamide	23950585	NC	2.1	2.09E-05		3.0	2.2		6.6	4.6		14	5.8E+05		1000
Pyrene	129000	NC	222	0.00		1.0	2.2		2.2	4.6		4.6	4.4E+05		1000
Pyridine (TC = 5.0)	110861	NC	1.0	0.00		0.040	2.2		0.088	4.6		0.18	4.4E+05		5.0
Safrole	94597	C	1.6	0.00		5.0E-04	2.2		0.0011	4.5		0.0023	4.1E+05		205
Strychnine and salts	57249	NC	1.2	0.00		0.010	2.2		0.022	4.6		0.046	4.4E+05		1000
Styrene	100425	NC	2.8	0.00	0.10	7.0	2.2	0.22	15	4.6	0.46	32	4.4E+05	1000	1000

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TCDDioxin 2, 3, 7, 8-	1746016	C	3348	0.00	3.0E-08	6.0E-10	2.2	6.6E-08	1.3E-09	4.5	1.4E-07	2.7E-09	4.1E+05	0.012	2.5E-04
Tetrachlorobenzene 1,2,4,5-	95943	NC	52.1	0.00		0.010	2.2		0.022	4.6		0.046	4.4E+05		1000
Tetrachloroethane 1,1,1,2- (degrades to Trichloroethylene)	630206	C	2.4	0.0041		0.0030	2.5	0.011	0.0075	7.2	0.023	0.022	*D	0.50	0.50
Tetrachloroethane 1,1,2,2- (degrades to Trichloroethylene)	79345	C	1.3	0.22		4.0E-04	39	0.011	0.016	4.0E+04	0.023	0.036	*D	0.50	0.50
Tetrachloroethylene (TC = 0.7)	127184	NC	1.4	0.00	0.0050	0.40	2.2	0.011	0.70	4.6	0.023	0.70	4.4E+05	0.70	0.70
Tetrachlorophenol 2,3,4,6-	58902	NC	1.6	0.00		1.0	2.2		2.2	4.6		4.6	4.4E+05		1000
Tetraethyl dithiopyrophosphate (Sulfotep)	3689245	NC	9.6	24		0.020	*L		1000	*L		1000	*L		1000
Toluene	108883	NC	1.7	0.00	1.0	7.0	2.2	2.2	15	4.6	4.6	32	4.4E+05	1000	1000
Toluenediamine 2,4-	95807	C	1.0	0.00		3.0E-05	2.2		6.6E-05	4.5		1.4E-04	4.1E+05		12
Toluidine o-	95534	C	1.0	0.00		4.0E-04	2.2		8.8E-04	4.5		0.0018	4.1E+05		164
Toluidine p-	106490	C	1.0	0.00		4.0E-04	2.2		8.8E-04	4.5		0.0018	4.1E+05		164
Toxaphene (chlorinated camphenes) (TC = 0.5)	8001352	C	55.3	0.020	0.0030	8.0E-05	3.6	0.011	2.9E-04	32	0.096	0.0026	*T	0.50	0.50
Tribromomethane (Bromoform)	75252	C	1.3	0.00014	0.10		2.2	0.22		4.7	0.47		1.0E+08	1000	
Trichloro-1,2,2-trifluoro- ethane 1,1,2-	76131	NC	3.5	0.00		1000	2.2		1000	4.6		1000	4.4E+05		1000
Trichlorobenzene 1,2,4-	120821	NC	25.2	0.00	0.070	0.40	2.2	0.15	0.88	4.6	0.32	1.8	4.4E+05	1000	1000
Trichloroethane 1,1,1-	71556	NC	1.4	0.22	0.20		39	7.8		4.0E+04	1000		*	1000	
Trichloroethane 1,1,2- (degrades to 1,1-Dichloroethylene)	79005	C	1.1	0.00080	0.0050	0.0010	2.3	0.012	2.2E-04	5.1	0.026	4.5E-04	1.7E+09	0.70	0.70
Trichloroethylene (1,1,2-Trichloroethylene) (TC = 0.5)	79016	C	1.3	0.00	0.0050	0.0080	2.2	0.011	0.018	4.5	0.023	0.036	4.1E+05	0.50	0.50
Trichlorofluoromethane (Freon 11)	75694	NC	1.3	0.00		10	2.2		22	4.6		46	4.4E+05		1000
Trichlorophenol 2,4,5- (TC = 400)	95954	NC	3.3	0.00		4.0	2.2		8.8	4.6		18	4.4E+05		400
Trichlorophenol 2,4,6- (TC = 2.0)	88062	C	1.5	0.00		0.0080	2.2		0.018	4.5		0.036	4.1E+05		2.0
Tris(2,3-dibromopropyl)phosphate	126727	C	5.1	0.027		9.0E-06	4.3		3.9E-05	53		4.8E-04	*		1000
Vinyl chloride (TC = 0.2)	75014	NC	1.0	0.00	0.0020	4.0E-05	2.2	0.0044	8.8E-05	4.6	0.0092	1.8E-04	4.4E+05	0.20	0.20
Xylenes (total)	1330207	NC	4.2	0.00	10	70	2.2	22	154	4.6	46	322	4.4E+05	1000	1000
Barium (TC = 100)	7440393	NC	NA	0.0	2			4.8			12			100	
Beryllium	7440417	C	NA	0.0		0.0040			0.0099			0.027			1000
Cadmium (TC = 1.0)	7440439	NC	NA	0.0	0.005			0.019			0.093			1.0	
Chromium (III)	16065381	NC	NA	0.0		40			448			1000			1000
Copper	7440508	NC	NA	0.0		1.0			2.9			9.0			1000
Lead (TC = 5.0)	7439921	C	NA	0.0		0.015			0.6745			5			5
Nickel	7440020	NC	NA	0.0	0.1			0.30			1.0			1000	
Silver (TC = 5.0)	7440224	NC	NA	0.0		0.20			0.52			1.4			5.0
Vanadium	7440622	NC	NA	0.0		0.30			1.2			3.8			1000
Zinc	7440666	NC	NA	0.0		10			27			83			1000
Antimony	7440360	NC	NA	0.0	0.006	0.014	3.5	0.021	0.048	19	0.11	0.26	*	1000	1000
Arsenic (TC = 5.0)	7440382	C	NA	0.0	0.05	5.68E-05	2.7	0.14	1.6E-04	10	0.52	5.9E-04	*	5.0	5.0
Chromium (VI) (TC = 5.0)	7440473	NC	NA	0.0	0.1	0.175	2.9	0.29	0.50	9.4	0.94	1.7	*	5.0	5.0
Mercury (TC = 0.2)	7439976	NC	NA	0.0	0.002	0.011	3.7	0.0075	0.041	20	0.040	0.20	*	0.20	0.20
Selenium (TC = 1.0)	7782492	NC	NA	0.0	0.05	0.175	2.6	0.13	0.46	6.9	0.35	1.0	*	1.0	1.0
Thallium	7440280	NC	NA	0.0	0.002		4.3	0.0087		5.5	0.011		*	1000	

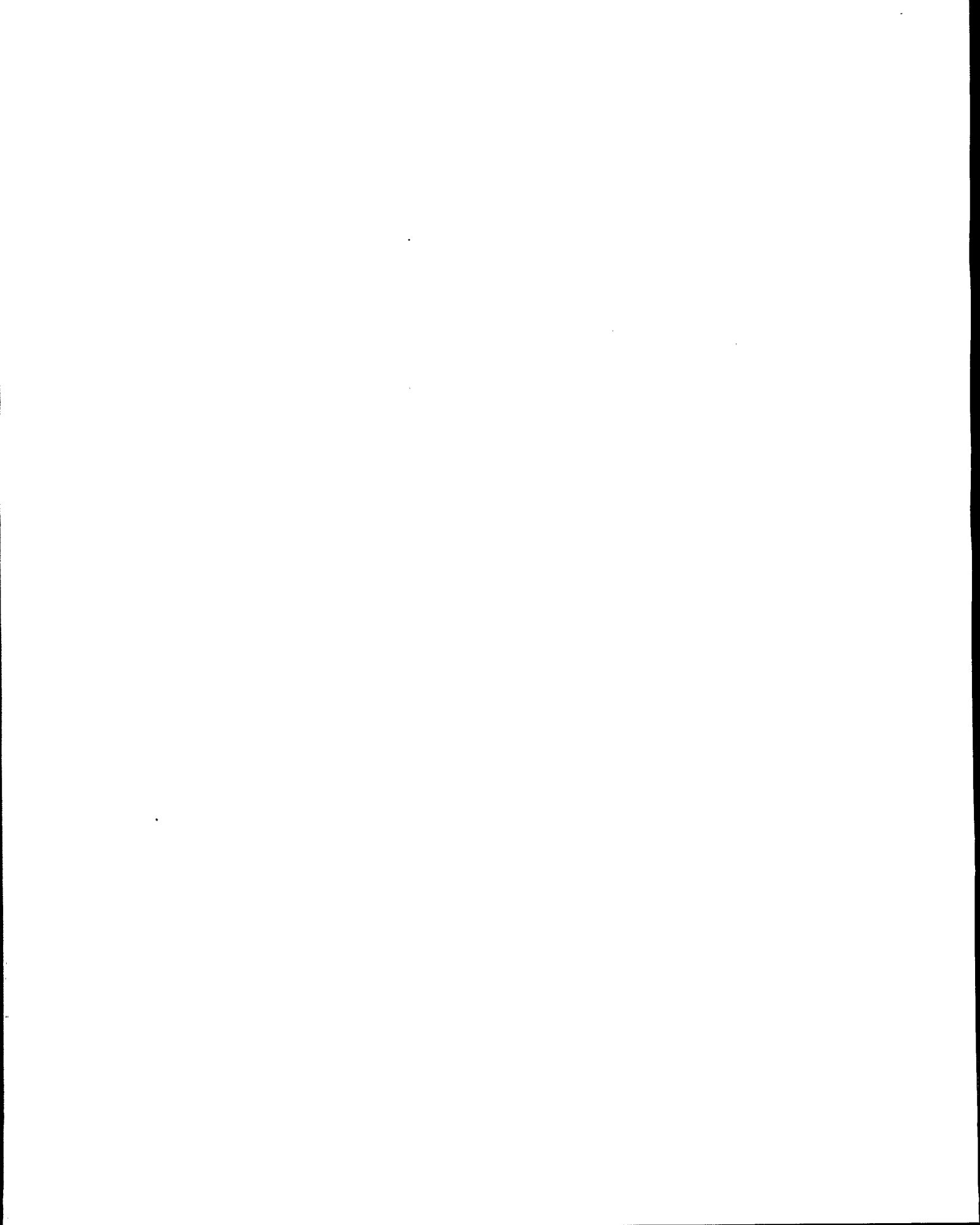
Draft LCTVs for Surface Impoundments

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Acenaphthene	83329	NC	16.0	0.00		2.0	2.2		4.4	50		100	2.2E+09		1000
Acetone (2-propanone)	67641	NC	1.0	0.00		4.0	1.1		4.4	4.8		19	1.3E+05		1000
Acetonitrile (methyl cyanide)	75058	NC	1.0	8.23E-07		0.20	1.1		0.22	4.9		0.98	1.3E+05		1000
Acetophenone	98862	NC	1.0	0.00		4.0	1.1		4.4	5.0		20	3.1E+05		1000
Acrolein	107028	NC	1.0	1.9E+08		0.70	*L		1000	*L		1000	*L		1000
Acrylamide	79061	C	1.0	0.0052		2.0E-05	1.9		3.8E-05	9.5		1.9E-04	*L		1000
Acrylonitrile (degrades to Acrylamide)	107131	C	1.0	0.00012		2.0E-04	1.8		3.8E-05	6.6		1.9E-04	1.9E+05		39
Aldrin	309002	C	4025	0.00		5.0E-06	360		0.0018	9.8E+09		1000	*L		1000
Aniline (benzeneamine)	62533	C	1.0	0.00		0.010	1.8		0.018	6.6		0.066	1.7E+05		1000
Benz[a]anthracene	56553	C	583	0.00		7.7E-05	50		0.0039	2.3E+08		1000	*L		1000
Benzene (TC = 0.5)	71432	C	1.2	0.00	0.0050		1.8	0.0090	0.0054	7.1	0.036	0.021	7.7E+05	0.50	0.50
Benzidine	92875	C	1.0	0.00		4.0E-07	1.8		7.2E-07	6.7		2.7E-06	3.2E+05		0.13
Benzo[a]pyrene	50328	C	1678	0.00	2.0E-04	1.0E-05	150	0.030	0.0015	3.3E+09	1000	1000	*L	1000	1000
Benzo[b]fluoranthene	205992	NC	1678	0.00		7.1E-05	150		0.011	2.1E+09		1000	*L		1000
Benzyl alcohol	100516	NC	1.0	0.00		10	1.1		11	4.9		49	2.0E+05		1000
Benzyl chloride (degrades to Benzyl alcohol)	100447	C	2.8	119		5.0E-04	*D		11	*D		49	*D		1000
Bis(2-chloroethyl)ether (degrades to 1,4-Dioxane)	111444	C	1.0	0.067		8.0E-05	2.3		1.8E-04	40		0.0032	*D		1000
Bis(2-chloroisopropyl)ether	39638329	C	1.7	0.00		0.0010	1.8		0.0018	8.4		0.0084	2.6E+06		1000
Bis(2-ethylhexyl)phthalate	117817	C	35864	7.15E-10	0.0060	0.0060	8.9E+04	531	531	*L	1000	1000	*L	1000	1000
Bromodichloromethane	75274	C	1.2	0.00079	0.080	0.0014	1.8	0.14	0.0025	8.1	0.65	0.011	1.4E+06	1000	1000
Bromomethane (degrades to Methanol)	74839	NC	1.0	2.7		0.050	28		1.4	2.5E+08		96	*L		1000
Butanol	71363	NC	1.0	0.00		4.0	1.1		4.4	4.9		20	1.7E+05		1000
Butyl-4,6-dinitrophenol, 2-sec-(Dinoseb)	88857	NC	1.3	0.00	0.0070	0.040	1.1	0.0077	0.044	5.6	0.039	0.22	1.2E+06	1000	1000
Butyl benzyl phthalate	85687	NC	46.1	4.76E-05		7.0	4.7		33	150		1000	*L		1000
Carbon disulfide	75150	NC	1.2	0.00049		4.0	1.1		4.4	6.0		24	7.8E+05		1000
Carbon tetrachloride (TC = 0.5)	56235	C	1.7	0.0049	0.0050	7.0E-04	1.9	0.0095	0.0013	36	0.18	0.025	*T	0.50	0.50
Chlordane (TC = 0.03)	57749	C	2065	3.34E-10	0.0020	7.0E-05	176	0.030	0.012	1.3E+05	0.030	0.030	*T	0.030	0.030
Chloro-1,3-butadiene 2-(Chloroprene)	126998	NC	1.1	0.00		0.70	1.1		0.77	5.3		3.7	6.8E+05		1000
Chloroaniline p-	106478	NC	1.1	0.00		0.10	1.1		0.11	5.2		0.52	5.3E+05		1000
Chlorobenzene (TC = 100)	108907	NC	2.0	0.00	0.10	0.70	1.2	0.12	0.84	7.7	0.77	5.4	3.8E+06	100	100
Chlorobenzilate	510156	C	30.2	0.0017		3.0E-04	4.1		0.0012	1.6E+04		4.8	*L		1000
Chlorodibromomethane	124481	C	1.2	0.00038	0.080	0.0010	1.8	0.14	0.0018	7.8	0.62	0.0078	6.2E+05	1000	622
Chloroform (TC = 6.0)	67663	C	1.1	7.46E-05	0.080	0.010	1.8	0.14	0.018	6.9	0.55	0.069	9.3E+05	6.0	6.0
Chloromethane	74873	C	1.0	0.00		6.6E-03	1.8		0.012	6.6		0.044	2.0E+05		1000
Chlorophenol 2-	95578	NC	1.2	0.00		0.20	1.1		0.22	5.4		1.1	7.9E+05		1000
Chloropropene, 3- (Allyl Chloride)	107051	NC	1.0	12		1.75	5634		1000	*L		1000	*L		1000
Chrysene	218019	NC	583	0.00		0.0027	50		0.14	1.5E+08		1000	*L		1000
Cresol m- (TC = 200)	108394	NC	1.2	0.00		2.0	1.1		2.2	5.3		11	6.8E+05		200
Cresol o- (TC = 200)	95487	NC	1.2	0.00		2.0	1.1		2.2	5.3		11	6.8E+05		200
Cresol p- (TC = 200)	106445	NC	1.2	0.00		0.20	1.1		0.22	5.3		1.1	6.8E+05		200
Cumene	98828	NC	7.7	0.00		1.0	1.6		1.6	24		24	2.5E+07		1000
DDD	72548	C	2065	0.0073		4.0E-04	6.7E+08		1000	*L		1000	*L		1000
DDE	72559	C	11606	0.00		3.0E-04	1972		0.59	*L		1000	*L		1000
DDT, p,p'- (degrades to DDE)	50293	C	10344	0.017		3.0E-04	*D		0.59	*D		1000	*D		1000
Di-n-butyl phthalate	84742	NC	63.3	3.47E-05		4.0	6.1		24	200		800	*L		1000

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Di-n-octyl phthalate	117840	NC	105841	8.99E-08		0.70	1.1E+10		1000	*L		1000	*L		1000
Diallate	2303164	C	40.3	0.029		0.0010	13		0.013	8.3E+05		830	*L		1000
Dibenz[a,h]anthracene	53703	C	8804	0.00		1.1E-05	1059		0.012	2.9E+15		1000	*L		1000
Dibromo-3-chloropropane 1,2-	96128	C	1.2	0.0029	2.0E-04	6.0E-05	1.8	3.6E-04	1.1E-04	13	0.0026	7.8E-04	1.1E+08	1000	1000
Dichlorobenzene 1,2-	95501	NC	4.2	0.00	0.60	3.0	1.3	0.78	3.9	14	8.4	42	1.2E+07	1000	1000
Dichlorobenzene 1,4- (TC = 7.5)	106467	C	4.0	0.00	0.075	0.0040	2.0	0.15	0.0080	15	1.1	0.060	1.1E+07	7.5	7.5
Dichlorobenzidine 3,3'-	91941	C	6.6	0.00		2.0E-04	2.1		4.2E-04	22		0.0044	2.1E+07		1000
Dichlorodifluoromethane (Freon 12)	75718	NC	1.4	0.00		7.0	1.2		8.4	5.9		41	1.5E+06		1000
Dichloroethane 1,1- (degrades to Vinyl chloride)	75343	C	1.1	0.0033		9.0E-04	1.8	0.0022	4.4E-05	9.8	0.0098	2.0E-04	6.3E+07	0.20	0.20
Dichlorophenol 2,4-	120832	NC	1.8	0.00		0.10	1.2		0.12	7.2		0.72	3.1E+06		1000
Dichlorophenoxyacetic acid 2,4-(2,4-D) (TC = 10)	94757	NC	1.0	0.00		0.40	1.1		0.44	4.9		2.0	1.7E+05		10
Dichloropropane 1,2-	78875	C	1.1	0.013	0.0050	0.0010	1.9	0.0095	0.0019	19	0.095	0.019	*L	1000	1000
Dichloropropene 1,3-(mixture of isomers)	542756	C	1.1	0.00		5.0E-04	1.8		9.0E-04	6.8		0.0034	3.9E+05		195
Dichloropropene cis-1,3-	10061015	C	1.2	12		5.0E-04	2.1E+04		11	*L		1000	*L		1000
Dichloropropene trans-1,3-	10061026	C	1.2	12		5.0E-04	2.1E+04		11	*L		1000	*L		1000
Dieldrin	60571	C	321	0.018		5.0E-06	2992		0.015	*L		1000	*L		1000
Diethyl phthalate	84662	NC	1.3	0.0045		30	1.2		36	15		450	1.4E+09		1000
Diethylstilbestrol	56531	C	33.7	0.00		2.0E-08	4.3		8.6E-08	110		2.2E-06	*L		1000
Dimethoate (degrades to Methanol)	60515	NC	1.0	0.57		0.0070	3.4		0.024	3300		23	*L		1000
Dimethoxybenzidine 3,3'-	119904	C	1.1	0.00		0.0060	1.8		0.011	6.8		0.041	4.3E+05		1000
Dimethyl phthalate (degrades to Methanol)	131113	NC	1.0	0.032		400	1.3		22	19		96	*L		1000
Dimethylbenz[a]anthracene 7,12-	57976	NC	11606	0.00		3.0E-06	1972		0.0059	*L		1000	*L		1000
Dimethylbenzidine 3,3'-	119937	C	1.9	0.00		9.0E-06	1.8		1.6E-05	9.2		8.3E-05	3.6E+06		32
Dimethylphenol 2,4-	105679	NC	1.5	0.00		0.70	1.2		0.84	6.3		4.4	2.0E+06		1000
Dinitrobenzene 1,3-	99650	NC	1.1	0.00		0.0040	1.1		0.0044	5.0		0.020	3.1E+05		1000
Dinitrophenol 2,4-	51285	NC	1.0	0.00		0.070	1.1		0.077	4.8		0.34	1.3E+05		1000
Dinitrotoluene 2,4- (TC = 0.13)	121142	NC	1.1	0.00		0.070	1.1		0.077	5.2		0.13	6.0E+05		0.13
Dinitrotoluene 2,6-	606202	NC	1.1	0.00		0.040	1.1		0.044	5.0		0.20	3.8E+05		1000
Dioxane 1,4-	123911	C	1.0	0.00		0.0080	1.8		0.014	6.6		0.053	1.3E+05		1000
Diphenylamine	122394	NC	6.3	0.00		0.90	1.5		1.4	20		18	1.9E+07		1000
Disulfoton	298044	NC	3.3	0.67		0.0010	32		0.032	1.4E+11		1000	*L		1000
Endosulfan (Endosulfan I and II, mixture)	115297	NC	10.4	0.64		0.20	627		125	*L		1000	*L		1000
Endrin (TC = 0.02)	72208	NC	107	0.016	0.0020	0.010	78	0.020	0.020	2.5E+08	0.020	0.020	*T	0.020	0.020
Epichlorohydrin	106898	C	1.0	9.0		0.0090	1966		18	*L		1000	*L		1000
Ethoxyethanol 2-	110805	NC	1.0	0.00		10	1.1		11	4.8		48	1.3E+05		1000
Ethyl acetate	141786	NC	1.0	0.063		30	1.4		42	21		630	*L		1000
Ethyl ether	60297	NC	1.0	0.00		7.0	1.1		7.7	4.9		34	1.7E+05		1000
Ethyl methacrylate	97632	NC	1.0	0.019		3.0	1.2		3.6	16		48	*L		1000
Ethyl methanesulfonate	62500	C	1.0	363		3.0E-07	*L		1000	*L		1000	*L		1000
Ethylbenzene	100414	NC	3.7	0.00	0.70	4.0	1.3	0.91	5.2	12	8.4	48	9.8E+06	1000	1000
Ethylene dibromide (1,2-Dibromoethane)	106934	C	1.1	0.18	5.0E-05	1.0E-06	3.1	1.6E-04	3.1E-06	1200	0.060	0.0012	*L	1000	1000
Ethylene thiourea	96457	C	1.0	0.00		2.0E-05	1.8		3.7E-05	6.6		1.3E-04	1.3E+05		2.7
Fluoranthene	206440	NC	114	0.00		1.0	10		10	370		370	*L		1000
Fluorene	86737	NC	22.6	0.00		1.0	2.8		2.8	71		71	*L		1000
Formaldehyde	50000	NC	1.0	0.00		7.0	1.1		7.7	4.8		34	1.3E+05		1000
Formic acid	64186	NC	1.0	0.00		70	1.1		77	4.8		336	1.3E+05		1000

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Furan	110009	NC	1.0	0.00		0.040	1.1		0.044	4.9		0.20	2.4E+05		1000
HCH beta-	319857	C	8.2	0.00		5.0E-05	2.2		1.1E-04	26		0.0013	2.7E+07		1000
HCH (Lindane) gamma- (TC = 0.4) (degrades to 1,2,4-Trichlorobenzene)	58899	C	7.7	0.31	2.0E-04	7.0E-05	51	0.010	0.0036	8.9E+07	0.40	0.40	*D	0.40	0.40
HCH alpha- (degrades to 1,2,4-Trichlorobenzene)	319846	C	8.2	0.31		1.0E-05	59	0.21	5.9E-04	2.3E+08	5.6	32	*L	1000	1000
Heptachlor (TC = 0.008)	76448	C	432	18	4.0E-04	2.0E-05	*T	0.0080	0.0080	*T	0.0080	0.0080	*T	0.0080	0.0080
Heptachlor epoxide	1024573	C	212	0.018	2.0E-04	9.0E-06	557	0.11	0.0050	*L	1000	1000	*T	1000	1000
Hexachloro-1,3-butadiene (TC = 0.5)	87683	C	77.7	0.00		0.0010	7.9		0.0079	250		0.25	*T		0.50
Hexachlorobenzene (TC = 0.13)	118741	C	686	0.00	0.0010	5.0E-05	59	0.059	0.0030	5.2E+08	0.13	0.13	*T	0.13	0.13
Hexachlorocyclopentadiene	77474	NC	141	7.2	0.050	0.30	*L	1000	1000	*L	1000	1000	*L	1000	1000
Hexachloroethane (TC = 3.0)	67721	C	11.8	0.00		0.0060	2.5		0.015	37		0.22	4.1E+07		3.0
Hexachlorophene	70304	NC	267	0.00		0.010	23		0.23	860		8.6	*L		1000
Indeno[1,2,3-cd]pyrene	193395	C	4839	0.00		2.1E-04	440		0.092	1.2E+10		1000	*L		1000
Isobutyl alcohol	78831	NC	1.0	0.00		10	1.1		11	4.9		49	1.7E+05		1000
Isophorone	78591	C	1.2	0.00		0.090	1.8		0.16	7.2		0.65	9.2E+05		1000
Kepone	143500	C	38.6	0.00		2.0E-06	4.7		9.4E-06	120		2.4E-04	1.0E+30		1000
Methacrylonitrile	126987	NC	1.0	0.00012		0.0040	1.1		0.0044	4.9		0.020	2.0E+05		787
Methanol	67561	NC	1.0	0.00		20	1.1		22	4.8		96	1.3E+05		1000
Methyl parathion (degrades to Methanol)	298000	NC	1.8	0.81		0.0090	14		0.13	5.9E+06		96	*L		1000
Methylcholanthrene 3-	56495	C	26587	0.00		3.0E-06	2.0E+04		0.061	*L		1000	*L		1000
Methylene bromide (Dibromomethane)	74953	NC	1.0	0.00		0.40	1.1		0.44	5.0		2.0	2.8E+05		1000
Methylene Chloride (Dichloromethane) (degrades to Formaldehyde)	75092	C	1.0	0.00029	0.0050	0.010	1.8	0.0090	0.018	6.8	0.034	0.068	3.5E+05	1000	1000
N-Nitroso-di-n-butylamine	924163	C	1.3	0.00		2.0E-05	1.8		3.6E-05	7.5		1.5E-04	1.4E+06		28
N-Nitroso-di-n-propylamine	621647	C	1.0	0.00		1.0E-05	1.8		1.8E-05	6.7		6.7E-05	2.4E+05		2.4
N-Nitrosodiethylamine	55185	C	1.0	0.00		6.0E-07	1.8		1.1E-06	6.6		4.0E-06	1.3E+05		0.078
N-Nitrosodimethylamine	62759	C	1.0	0.00		2.0E-06	1.8		3.6E-06	6.6		1.3E-05	1.7E+05		0.34
N-Nitrosodiphenylamine	86306	C	2.8	0.00		0.020	1.9		0.038	12		0.24	7.0E+06		1000
N-Nitrosomethylethylamine	10595956	C	1.0	0.00		4.0E-06	1.8		7.2E-06	6.7		2.7E-05	2.4E+05		0.96
N-Nitrosopiperidine	100754	C	1.0	0.00		2.0E-06	1.8		3.6E-06	6.6		1.3E-05	1.3E+05		0.26
N-Nitrosopyrrolidine	930552	C	1.0	0.00		4.0E-05	1.8		7.2E-05	6.6		2.6E-04	1.3E+05		5.2
Naphthalene	91203	NC	4.4	0.00		1.0	1.4		1.4	15		15	1.3E+07		1000
Nitrobenzene (TC = 2.0)	98953	NC	1.1	0.00		0.020	1.1		0.022	5.1		0.10	4.6E+05		2.0
Octamethyl pyrophosphoramide	152169	NC	1.0	8.80E-05		0.070	1.1		0.077	4.9		0.34	1.8E+05		1000
Parathion (ethyl)	56382	NC	4.8	0.71		0.20	77		15	6.7E+14		1000	*L		1000
Pentachlorobenzene	608935	NC	654	0.00		0.030	56		1.7	2.8E+08		1000	*L		1000
Pentachloronitrobenzene (PCNB)	82688	C	100	0.00		3.0E-04	9.7		0.0029	320		0.096	*L		1000
Pentachlorophenol (TC = 100)	87865	C	4.1	0.00	0.0010	7.0E-04	2.0	0.0020	0.0014	15	0.015	0.011	1.2E+07	100	100
Phenol	108952	NC	1.0	0.00		20	1.1		22	5.0		100	3.1E+05		1000
Phenyl mercuric acetate	62384	NC	1.0	0.00		0.0028	1.1		0.0031	4.8		0.013	1.3E+05		364
Phenylenediamine, 1,3-	108452	NC	1.0	0.00		0.20	1.1		0.22	4.8		0.96	1.3E+05		1000
Phorate	298022	NC	2.2	18		0.0070	6.3E+07		1000	*L		1000	*L		1000
Polychlorinated biphenyls (Aroclors)	1336363	C	4119	0.00	5.0E-04	1.0E-05	370	0.19	0.0037	1.0E+10	1000	1000	*L	1000	1000
Pronamide	23950585	NC	2.1	2.09E-05		3.0	1.2		3.6	8.1		24	5.6E+06		1000
Pyrene	129000	NC	222	0.00		1.0	19		19	720		720	*L		1000
Pyridine (TC = 5.0)	110861	NC	1.0	0.00		0.040	1.1		0.044	4.9		0.20	1.7E+05		5.0
Safrole	94597	C	1.6	0.00		5.0E-04	1.8		9.0E-04	8.2		0.0041	2.3E+06		1000

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Strychnine and salts	57249	NC	1.2	0.00		0.010	1.1		0.011	5.4		0.054	9.0E+05		1000
Styrene	100425	NC	2.8	0.00	0.10	7.0	1.2	0.12	8.4	10	1.0	70	6.8E+06	1000	1000
TCDDioxin 2, 3, 7, 8-	1746016	C	3348	0.00	3.0E-08	6.0E-10	300	9.0E-06	1.8E-07	7.9E+09	237	4.7	*L	1000	1000
Tetrachlorobenzene 1,2,4,5-	95943	NC	52.1	0.00		0.010	5.2		0.052	170		1.7	*L		1000
Tetrachloroethane 1,1,1,2- (degrades to Trichloroethylene)	630206	C	2.4	0.0041		0.0030	1.9	0.0090	0.0057	54	0.038	0.060	*D	0.50	0.50
Tetrachloroethane 1,1,2,2- (degrades to Trichloroethylene)	79345	C	1.3	0.22		4.0E-04	3.9	0.0090	0.0016	3.4E+04	0.038	0.060	*D	0.50	0.50
Tetrachloroethylene (TC = 0.7)	127184	NC	1.4	0.00	0.0050	0.40	1.2	0.0060	0.48	6.1	0.031	0.70	1.7E+06	0.70	0.70
Tetrachlorophenol 2,3,4,6-	58902	NC	1.6	0.00		1.0	1.2		1.2	6.4		6.4	2.2E+06		1000
Tetraethyl dithiopyrophosphate (Sulfotep)	3689245	NC	9.6	24		0.020	*L		1000	*L		1000	*L		1000
Toluene	108883	NC	1.7	0.00	1.0	7.0	1.2	1.2	8.4	6.9	6.9	48	2.8E+06	1000	1000
Toluenediamine 2,4-	95807	C	1.0	0.00		3.0E-05	1.8		5.4E-05	6.6		2.0E-04	1.3E+05		3.9
Toluidine o-	95534	C	1.0	0.00		4.0E-04	1.8		7.2E-04	6.7		0.0027	3.2E+05		128
Toluidine p-	106490	C	1.0	0.00		4.0E-04	1.8		7.2E-04	6.7		0.0027	3.2E+05		128
Toxaphene (chlorinated camphenes) (TC = 0.5)	8001352	C	55.3	0.020	0.0030	8.0E-05	12	0.036	9.6E-04	6.4E+05	0.50	0.50	*T	0.50	0.50
Tribromomethane (Bromoform)	75252	C	1.3	0.00014	0.10		1.8	0.18		7.6	0.76		3.6E+05	1000	
Trichloro-1,2,2-trifluoro- ethane 1,1,2-	76131	NC	3.5	0.00		1000	1.3		1000	12		1000	9.2E+06		1000
Trichlorobenzene 1,2,4-	120821	NC	25.2	0.00	0.070	0.40	3.0	0.21	1.2	80	5.6	32	*L	1000	1000
Trichloroethane 1,1,1-	71556	NC	1.4	0.22	0.20		2.6	0.52		2.8E+04	1000		*L	1000	
Trichloroethane 1,1,2- (degrades to 1,1-Dichloroethylene)	79005	C	1.1	0.00080	0.0050	0.0010	1.8	0.0090	1.8E-04	8.0	0.040	7.0E-04	1.4E+06	0.70	0.70
Trichloroethylene (1,1,2-Trichloroethylene) (TC = 0.5)	79016	C	1.3	0.00	0.0050	0.0080	1.8	0.0090	0.014	7.5	0.038	0.060	1.4E+06	0.50	0.50
Trichlorofluoromethane (Freon 11)	75694	NC	1.3	0.00		10	1.2		12	5.8		58	1.4E+06		1000
Trichlorophenol 2,4,5- (TC = 400)	95954	NC	3.3	0.00		4.0	1.3		5.2	11		44	8.4E+06		400
Trichlorophenol 2,4,6- (TC = 2.0)	88062	C	1.5	0.00		0.0080	1.8		0.014	7.9		0.063	1.9E+06		2.0
Trichlorophenoxy)propionic acid 2-(2,4,5-(Silvex) (TC = 1.0)	93721	NC	1.1	0.00		0.30	1.1		0.33	5.3		1.0	6.8E+05		1.0
Vinyl chloride (TC = 0.2)	75014	NC	1.0	0.00	0.0020	4.0E-05	1.1	0.0022	4.4E-05	4.9	0.0098	2.0E-04	2.4E+05	0.20	0.20
Xylenes (total)	1330207	NC	4.2	0.00	10	70	1.3	13	91	14	140	980	1.2E+07	1000	1000
Barium (TC = 100)	7440393	NC	NA	NA	2			5.3			95			100	
Beryllium	7440417	C	NA	NA		0.0040			0.018			0.28			1000
Cadmium (TC = 1.0)	7440439	NC	NA	NA	0.005			0.077			1.0			1.0	
Chromium (III)	16065381	NC	NA	NA		40			1000			1000			1000
Copper	7440508	NC	NA	NA		1.0			7.1			164			1000
Lead (TC = 5.0)	7439921	C	NA	NA		0.015			5			5			5
Nickel	7440020	NC	NA	NA	0.1			1.1			28			1000	
Silver (TC = 5.0)	7440224	NC	NA	NA		0.20			0.81			5.0			5.0
Vanadium	7440622	NC	NA	NA		0.30			3.6			119			1000
Zinc	7440666	NC	NA	NA		10			63			1000			1000
Antimony	7440360	NC	NA	NA	0.006	0.014	45	0.27	0.63	1360	8.2	19	*L	1000	1000
Arsenic (TC = 5.0)	7440382	C	NA	NA	0.05	5.7E-05	33	1.7	0.0019	969	5.0	0.055	*T	5.0	5.0
Chromium (VI) (TC = 5.0)	7440473	NC	NA	NA	0.1	0.175	23	2.3	4.0	645	5.0	5.0	*T	5.0	5.0
Mercury (TC = 0.2)	7439976	NC	NA	NA	0.002	0.011	15	0.030	0.17	545	0.20	0.20	*T	0.20	0.20
Selenium (TC = 1.0)	7782492	NC	NA	NA	0.05	0.175	6.7	0.33	1.0	166	1.0	1.0	*T	1.0	1.0
Thallium	7440280	NC	NA	NA	0.002		73	0.15		2380	4.8		*L	1000	



Draft LCTVs for Waste Piles

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Acenaphthene	83329	NC	16.0	0.00		2.0	64		128	230		460	*L		1000
Acetone (2-propanone)	67641	NC	1.0	0.00		4.0	8.6		34	21		84	2.4E+09		1000
Acetonitrile (methyl cyanide)	75058	NC	1.0	8.23E-07		0.20	8.6		1.7	21		4.2	2.4E+09		1000
Acetophenone	98862	NC	1.0	0.00		4.0	8.8		35	21		84	9.1E+11		1000
Acrolein	107028	NC	1.0	1.9E+08		0.70	*L		1000	*L		1000	*L		1000
Acrylamide	79061	C	1.0	0.0052		2.0E-05	15		3.0E-04	41		8.2E-04	*L		1000
Acrylonitrile (degrades to Acrylamide)	107131	C	1.0	0.00012		2.0E-04	12		3.0E-04	28		8.2E-04	6.8E+09		1000
Aldrin	309002	C	4025	0.00		5.0E-06	4.6E+10		1000	1.5E+13		1000	*L		1000
Aniline (benzenamine)	62533	C	1.0	0.00		0.010	12		0.12	28		0.28	1.5E+11		1000
Benz[a]anthracene	56553	C	583	0.00		7.7E-05	3400		0.26	4.9E+04		3.8	*L		1000
Benzene (TC = 0.5)	71432	C	1.2	0.00	0.0050	0.0030	13	0.065	0.039	30	0.15	0.090	2.6E+12	0.50	0.50
Benzidine	92875	C	1.0	0.00		4.0E-07	12		4.8E-06	29		1.2E-05	7.6E+11		1000
Benzo[a]pyrene	50328	C	1678	0.00	2.0E-04	1.0E-05	1.0E+10	1000	1000	3.3E+12	1000	1000	*L	1000	1000
Benzo[b]fluoranthene	205992	NC	1678	0.00		7.1E-05	1.1E+10		1000	3.7E+12		1000	*L		1000
Benzyl alcohol	100516	NC	1.0	0.00		10	8.7		87	21		210	3.6E+11		1000
Benzyl chloride (degrades to Benzyl alcohol)	100447	C	2.8	119		5.0E-04	*D		87	*D		210	*D		1000
Bis(2-chloroethyl)ether (degrades to 1,4-Dioxane)	111444	C	1.0	0.067		8.0E-05	50		0.0040	300		0.024	*L		1000
Bis(2-chloroisopropyl)ether	39638329	C	1.7	0.00		0.0010	14		0.014	37		0.037	*L		1000
Bis(2-ethylhexyl)phthalate	117817	C	35864	7.15E-10	0.0060	0.0060	*L	1000	1000	*L	1000	1000	*L	1000	1000
Bromodichloromethane	75274	C	1.2	0.00079	0.080	0.0014	13	1.0	0.018	32	2.6	0.045	*L	1000	1000
Bromomethane (degrades to Methanol)	74839	NC	1.0	2.7		0.050	2.1E+06		172	1.1E+11		420	*L		1000
Butanol	71363	NC	1.0	0.00		4.0	8.7		35	21		84	1.8E+11		1000
Butyl-4,6-dinitrophenol, 2-sec-(Dinoseb)	88857	NC	1.3	0.00	0.0070	0.040	9.7	0.068	0.39	24	0.17	0.96	5.1E+12	1000	1000
Butyl benzyl phthalate	85687	NC	46.1	4.76E-05		7.0	180		1000	660		1000	*L		1000
Carbon disulfide	75150	NC	1.2	0.00049		4.0	9.4		38	24		96	*L		1000
Carbon tetrachloride (TC = 0.5)	56235	C	1.7	0.0049	0.0050	7.0E-04	19	0.095	0.013	75	0.38	0.053	*T	0.50	0.50
Chlordane (TC = 0.03)	57749	C	2065	3.34E-10	0.0020	7.0E-05	1.6E+10	0.030	0.030	4.5E+06	0.030	0.030	*T	0.030	0.030
Chloro-1,3-butadiene 2-(Chloroprene)	126998	NC	1.1	0.00		0.70	9.2		6.4	23		16	2.7E+12		1000
Chloroaniline p-	106478	NC	1.1	0.00		0.10	9.0		0.90	22		2.2	2.0E+12		1000
Chlorobenzene (TC = 100)	108907	NC	2.0	0.00	0.10	0.70	12	1.2	8.4	35	3.5	25	*T	100	100
Chlorobenzilate	510156	C	30.2	0.0017		3.0E-04	1400		0.42	5.0E+05		150	*L		1000
Chlorodibromomethane	124481	C	1.2	0.00038	0.080	0.0010	13	1.0	0.013	32	2.6	0.032	*L	1000	1000
Chloroform (TC = 6.0)	67663	C	1.1	7.46E-05	0.080	0.010	12	0.96	0.12	29	2.3	0.29	7.5E+11	6.0	6.0
Chloromethane	74873	C	1.0	0.00		6.6E-03	12		0.079	28		0.18	3.6E+11		1000
Chlorophenol 2-	95578	NC	1.2	0.00		0.20	9.3		1.9	23		4.6	3.3E+12		1000
Chloropropene, 3- (Allyl Chloride)	107051	NC	1.0	12		1.75	*L		1000	*L		1000	*L		1000
Chrysene	218019	NC	583	0.00		0.0027	3300		8.9	4.7E+04		127	*L		1000
Cresol m- (TC = 200)	108394	NC	1.2	0.00		2.0	9.2		18	23		46	2.7E+12		200
Cresol o- (TC = 200)	95487	NC	1.2	0.00		2.0	9.2		18	23		46	2.7E+12		200
Cresol p- (TC = 200)	106445	NC	1.2	0.00		0.20	9.2		1.8	23		4.6	2.7E+12		200
Cumene	98828	NC	7.7	0.00		1.0	33		33	110		110	*L		1000
DDD	72548	C	2065	0.0073		4.0E-04	*L		1000	*L		1000	*L		1000
DDE	72559	C	11606	0.00		3.0E-04	1.0E+12		1000	*L		1000	*L		1000
DDT, p,p'- (degrades to DDE)	50293	C	10344	0.017		3.0E-04	*D		1000	*L		1000	*L		1000

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							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Di-n-butyl phthalate	84742	NC	63.3	3.47E-05		4.0	240		960	900		1000	*L		1000
Di-n-octyl phthalate	117840	NC	105841	8.99E-08		0.70	*L		1000	*L		1000	*L		1000
Diallyl	2303164	C	40.3	0.029		0.0010	8.1E+05		810	1.9E+07		1000	*L		1000
Dibenz[a,h]anthracene	53703	C	8804	0.00		1.1E-05	1.2E+11		1000	347		0.0038	*		1000
Dibromo-3-chloropropane 1,2-	96128	C	1.2	0.0029	2.0E-04	6.0E-05	14	0.0028	8.4E-04	41	0.0082	0.0025	*	1000	1000
Dichlorobenzene 1,2-	95501	NC	4.2	0.00	0.60	3.0	20	12	60	66	40	198	*	1000	1000
Dichlorobenzene 1,4- (TC = 7.5)	106467	C	4.0	0.00	0.075	0.0040	23	1.7	0.092	70	5.3	0.28	*T	7.5	7.5
Dichlorobenzidine 3,3'-	91941	C	6.6	0.00		2.0E-04	32		0.0064	110		0.022	*L		1000
Dichlorodifluoromethane (Freon 12)	75718	NC	1.4	0.00		7.0	10		70	26		182	6.9E+12		1000
Dichloroethane 1,1- (degrades to Vinyl chloride)	75343	C	1.1	0.0033		9.0E-04	14	0.017	3.5E-04	35	0.042	8.4E-04	*D	0.20	0.20
Dichlorophenol 2,4-	120832	NC	1.8	0.00		0.10	12		1.2	32		3.2	*L		1000
Dichlorophenoxyacetic acid 2,4-(2,4-D) (TC = 10)	94757	NC	1.0	0.00		0.40	8.7		3.5	21		8.4	1.8E+11		10
Dichloropropane 1,2-	78875	C	1.1	0.013	0.0050	0.0010	17	0.085	0.017	54	0.27	0.054	*L	1000	1000
Dichloropropene 1,3-(mixture of isomers)	542756	C	1.1	0.00		5.0E-04	12		0.0060	29		0.015	1.1E+12		1000
Dichloropropene cis-1,3-	10061015	C	1.2	12		5.0E-04	*L		1000	*L		1000	*L		1000
Dichloropropene trans-1,3-	10061026	C	1.2	12		5.0E-04	*L		1000	*L		1000	*L		1000
Dieldrin	60571	C	321	0.018		5.0E-06	2.3E+12		1000	*L		1000	*L		1000
Diethyl phthalate	84662	NC	1.3	0.0045		30	11		330	38		1140	*L		1000
Diethylstilbestrol	56531	C	33.7	0.00		2.0E-08	130		2.6E-06	490		9.8E-06	*L		1000
Dimethoate (degrades to Methanol)	60515	NC	1.0	0.57		0.0070	1100		7.7	5.2E+04		364	*L		1000
Dimethoxybenzidine 3,3'-	119904	C	1.1	0.00		0.0060	12		0.072	29		0.17	1.2E+12		1000
Dimethyl phthalate (degrades to Methanol)	131113	NC	1.0	0.032		400	18		172	70		420	*L		1000
Dimethylbenz[a]anthracene 7,12-	57976	NC	11606	0.00		3.0E-06	8.2E+11		1000	*L		1000	*L		1000
Dimethylbenzidine 3,3'-	119937	C	1.9	0.00		9.0E-06	15		1.4E-04	41		3.7E-04	*L		1000
Dimethylphenol 2,4-	105679	NC	1.5	0.00		0.70	11		7.7	28		20	9.4E+12		1000
Dinitrobenzene 1,3-	99650	NC	1.1	0.00		0.0040	8.8		0.035	21		0.084	9.1E+11		1000
Dinitrophenol 2,4-	51285	NC	1.0	0.00		0.070	8.6		0.60	21		1.5	2.4E+09		1000
Dinitrotoluene 2,4- (TC = 0.13)	121142	NC	1.1	0.00		0.070	9.1		0.13	22		0.13	2.4E+12		0.13
Dinitrotoluene 2,6-	606202	NC	1.1	0.00		0.040	8.9		0.36	21		0.84	1.3E+12		1000
Dioxane 1,4-	123911	C	1.0	0.00		0.0080	12		0.096	28		0.22	2.5E+09		1000
Diphenylamine	122394	NC	6.3	0.00		0.90	28		25	95		86	*L		1000
Disulfoton	298044	NC	3.3	0.67		0.0010	3.0E+06		1000	1.9E+10		1000	*L		1000
Endosulfan (Endosulfan I and II, mixture)	115297	NC	10.4	0.64		0.20	2.8E+12		1000	*L		1000	*L		1000
Endrin (TC = 0.02)	72208	NC	107	0.016	0.0020	0.010	6.2E+10	0.020	0.020	6.8E+09	0.020	0.020	*T	0.020	0.020
Epichlorohydrin	106898	C	1.0	9.0		0.0090	1.9E+13		1000	*L		1000	*L		1000
Ethoxyethanol 2-	110805	NC	1.0	0.00		10	8.6		86	21		210	2.4E+09		1000
Ethyl acetate	141786	NC	1.0	0.063		30	24		720	130		1000	*L		1000
Ethyl ether	60297	NC	1.0	0.00		7.0	8.7		61	21		147	1.8E+11		1000
Ethyl methacrylate	97632	NC	1.0	0.019		3.0	15		45	53		159	*L		1000
Ethyl methanesulfonate	62500	C	1.0	363		3.0E-07	*L		1000	*L		1000	*L		1000
Ethylbenzene	100414	NC	3.7	0.00	0.70	4.0	18	13	72	58	41	232	*L	1000	1000
Ethylene dibromide (1,2-Dibromoethane)	106934	C	1.1	0.18	5.0E-05	1.0E-06	2400	0.12	0.0024	3.0E+04	1.5	0.030	*L	1000	1000
Ethylene thiourea	96457	C	1	0.0000		2.0E-05	12		2.4E-04	28		5.7E-04	2.5E+09		1000
Fluoranthene	206440	NC	114	0.00		1.0	460		460	2700		1000	*L		1000
Fluorene	86737	NC	22.6	0.00		1.0	88		88	330		330	*L		1000
Formaldehyde	50000	NC	1.0	0.00		7.0	8.6		60	21		147	2.4E+09		1000

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Formic acid	64186	NC	1.0	0.00		70	8.6		602	21		1000	2.4E+09		1000
Furan	110009	NC	1.0	0.00		0.040	8.7		0.35	21		0.84	5.5E+11		1000
HCH beta-	319857	C	8.2	0.00		5.0E-05	38		0.0019	130		0.0065	*L		1000
HCH (Lindane) gamma- (TC = 0.4) (degrades to 1,2,4-Trichlorobenzene)	58899	C	7.7	0.31	2.0E-04	7.0E-05	2.0E+06	0.40	0.40	5.3E+10	0.40	0.40	*T	0.40	0.40
HCH alpha- (degrades to 1,2,4-Trichlorobenzene)	319846	C	8.2	0.31		1.0E-05	2.1E+06	6.9	21	5.5E+11	25	144	*	1000	1000
Heptachlor (TC = 0.008)	76448	C	432	18	4.0E-04	2.0E-05	*T	0.0080	0.0080	*T	0.0080	0.0080	*L	0.0080	0.0080
Heptachlor epoxide	1024573	C	212	0.018	2.0E-04	9.0E-06	1.2E+12	1000	1000	*L	1000	1000	*L	1000	1000
Hexachloro-1,3-butadiene (TC = 0.5)	87683	C	77.7	0.00		0.0010	290		0.29	1100		0.50	*T		0.50
Hexachlorobenzene (TC = 0.13)	118741	C	686	0.00	0.0010	5.0E-05	4000	0.13	0.13	5.9E+04	0.13	0.13	*T	0.13	0.13
Hexachlorocyclopentadiene	77474	NC	141	7.2	0.050	0.30	*L	1000	1000	*L	1000	1000	*L	1000	1000
Hexachloroethane (TC = 3.0)	67721	C	11.8	0.00		0.0060	52		0.31	180		1.1	*T		3.0
Hexachlorophene	70304	NC	267	0.00		0.010	1400		14	1.7E+04		170	*L		1000
Indeno[1,2,3-cd]pyrene	193395	C	4839	0.00		2.1E-04	5.9E+10		1000	1.9E+13		1000	*L		1000
Isobutyl alcohol	78831	NC	1.0	0.00		10	8.7		87	21		210	1.8E+11		1000
Isophorone	78591	C	1.2	0.00		0.090	13		1.2	31		2.8	3.2E+12		1000
Kepone	143500	C	38.6	0.00		2.0E-06	150		3.0E-04	560		0.0011	*L		1000
Methacrylonitrile	126987	NC	1.0	0.00012		0.0040	8.6		0.034	21		0.084	6.6E+09		1000
Methanol	67561	NC	1.0	0.00		20	8.6		172	21		420	2.4E+09		1000
Methyl parathion (degrades to Methanol)	298000	NC	1.8	0.81		0.0090	1.2E+06		172	7.0E+10		420	*L		1000
Methylcholanthrene 3-	56495	C	26587	0.00		3.0E-06	*L		1000	*L		1000	*L		1000
Methylene bromide (Dibromomethane)	74953	NC	1.0	0.00		0.40	8.8		3.5	21		8.4	7.3E+11		1000
Methylene Chloride (Dichloromethane) (degrades to Formaldehyde)	75092	C	1.0	0.00029	0.0050	0.010	12	0.060	0.12	28	0.14	0.28	*L	1000	1000
N-Nitroso-di-n-butylamine	924163	C	1.3	0.00		2.0E-05	13		2.6E-04	32		6.4E-04	5.0E+12		1000
N-Nitroso-di-n-propylamine	621647	C	1.0	0.00		1.0E-05	12		1.2E-04	28		2.8E-04	4.6E+11		1000
N-Nitrosodiethylamine	55185	C	1.0	0.00		6.0E-07	12		7.2E-06	28		1.7E-05	2.5E+09		1000
N-Nitrosodimethylamine	62759	C	1.0	0.00		2.0E-06	12		2.4E-05	28		5.6E-05	1.5E+11		1000
N-Nitrosodiphenylamine	86306	C	2.8	0.00		0.020	19		0.38	54		1.1	*L		1000
N-Nitrosomethylethylamine	10595956	C	1.0	0.00		4.0E-06	12		4.8E-05	28		1.1E-04	4.6E+11		1000
N-Nitrosopiperidine	100754	C	1.0	0.00		2.0E-06	12		2.4E-05	28		5.6E-05	2.5E+09		1000
N-Nitrosopyrrolidine	930552	C	1.0	0.00		4.0E-05	12		4.8E-04	28		0.0011	2.5E+09		1000
Naphthalene	91203	NC	4.4	0.00		1.0	21		21	69		69	*L		1000
Nitrobenzene (TC = 2.0)	98953	NC	1.1	0.00		0.020	9.0		0.18	22		0.44	1.6E+12		2.0
Octamethyl pyrophosphoramidate	152169	NC	1.0	8.80E-05		0.070	8.6		0.60	21		1.5	5.7E+09		1000
Parathion (ethyl)	56382	NC	4.8	0.71		0.20	2.9E+09		1000	3.2E+19		1000	*L		1000
Pentachlorobenzene	608935	NC	654	0.00		0.030	3800		114	5.4E+04		1000	*L		1000
Pentachloronitrobenzene (PCNB)	82688	C	100	0.00		3.0E-04	370		0.11	1400		0.42	*L		1000
Pentachlorophenol (TC = 100)	87865	C	4.1	0.00	0.0010	7.0E-04	23	0.023	0.016	71	0.071	0.050	*T	100	100
Phenol	108952	NC	1.0	0.00		20	8.8		176	21		420	9.1E+11		1000
Phenyl mercuric acetate	62384	NC	1.0	0.00		0.0028	8.6		0.024	21		0.057	2.4E+09		1000
Phenylenediamine, 1,3-	108452	NC	1.0	0.00		0.20	8.6		1.7	21		4.2	2.4E+09		1000
Phorate	298022	NC	2.2	18		0.0070	*L		1000	*L		1000	*L		1000
Polychlorinated biphenyls (Aroclors)	1336363	C	4119	0.00	5.0E-04	1.0E-05	4.8E+10	1000	1000	1.5E+13	1000	1000	*L	1000	1000
Pronamide	23950585	NC	2.1	2.09E-05		3.0	13		39	36		108	*L		1000
Pyrene	129000	NC	222	0.00		1.0	1100		1000	1.3E+04		1000	*L		1000
Pyridine (TC = 5.0)	110861	NC	1.0	0.00		0.040	8.7		0.35	21		0.84	1.8E+11		5.0

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil			Single Liner			Composite Liner		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)	DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Safrole	94597	C	1.6	0.00		5.0E-04	14		0.0070	36		0.018	*L		1000
Strychnine and salts	57249	NC	1.2	0.00		0.010	9.4		0.094	23		0.23	3.8E+12		1000
Styrene	100425	NC	2.8	0.00	0.10	7.0	15	1.5	105	47	4.7	329	*L	1000	1000
TCDDioxin 2,3,7,8-	1746016	C	3348	0.00	3.0E-08	6.0E-10	3.6E+10	1000	22	1.2E+13	1000	1000	*L	1000	1000
Tetrachlorobenzene 1,2,4,5-	95943	NC	52.1	0.00		0.010	200		2.0	740		7.4	*L		1000
Tetrachloroethane 1,1,1,2- (degrades to Trichloroethylene)	630206	C	2.4	0.0041		0.0030	24	0.065	0.072	100	0.16	0.26	*D	0.50	0.50
Tetrachloroethane 1,1,2,2- (degrades to Trichloroethylene)	79345	C	1.3	0.22		4.0E-04	2.5E+04	0.065	0.10	2.9E+06	0.16	0.26	*D	0.50	0.50
Tetrachloroethylene (TC = 0.7)	127184	NC	1.4	0.00	0.0050	0.40	10	0.050	0.70	27	0.14	0.70	7.8E+12	0.70	0.70
Tetrachlorophenol 2,3,4,6-	58902	NC	1.6	0.00		1.0	11		11	28		28	*L		1000
Tetraethyl dithiopyrophosphate (Sulfotep)	3689245	NC	9.6	24		0.020	*L		1000	*L		1000	*L		1000
Toluene	108883	NC	1.7	0.00	1.0	7.0	11	11	77	31	31	217	*L	1000	1000
Toluenediamine 2,4-	95807	C	1.0	0.00		3.0E-05	12		3.6E-04	28		8.4E-04	2.5E+09		1000
Toluidine o-	95534	C	1.0	0.00		4.0E-04	12		0.0048	29		0.012	7.6E+11		1000
Toluidine p-	106490	C	1.0	0.00		4.0E-04	12		0.0048	29		0.012	7.6E+11		1000
Toxaphene (chlorinated camphenes) (TC = 0.5)	8001352	C	55.3	0.020	0.0030	8.0E-05	5.3E+05	0.50	0.50	1.9E+07	0.50	0.50	*T	0.50	0.50
Tribromomethane (Bromoform)	75252	C	1.3	0.00014	0.10		13	1.3		32	3.2		*L	1000	
Trichloro-1,2,2-trifluoro- ethane 1,1,2-	76131	NC	3.5	0.00		1000	18		1000	56		1000	*L		1000
Trichlorobenzene 1,2,4-	120821	NC	25.2	0.00	0.070	0.40	98	6.9	39	360	25	144	*L	1000	1000
Trichloroethane 1,1,1-	71556	NC	1.4	0.22	0.20		2.1E+04	1000		3.2E+06	1000		*L	1000	
Trichloroethane 1,1,2- (degrades to 1,1-Dichloroethylene)	79005	C	1.1	0.00080	0.0050	0.0010	13	0.065	0.0012	31	0.16	0.0030	*D	0.70	0.70
Trichloroethylene (1,1,2-Trichloroethylene) (TC = 0.5)	79016	C	1.3	0.00	0.0050	0.0080	13	0.065	0.10	32	0.16	0.26	5.0E+12	0.50	0.50
Trichlorofluoromethane (Freon 11)	75694	NC	1.3	0.00		10	9.9		99	25		250	6.2E+12		1000
Trichlorophenol 2,4,5- (TC = 400)	95954	NC	3.3	0.00		4.0	17		68	52		208	*T		400
Trichlorophenol 2,4,6- (TC = 2.0)	88062	C	1.5	0.00		0.0080	14		0.11	34		0.27	7.2E+12		2.0
Trichlorophenoxypropionic acid 2-(2,4,5-(Silvex) (TC = 1.0)	93721	NC	1.1	0.00		0.30	9.2		1.0	23		1.0	2.7E+12		1.0
Vinyl chloride (TC = 0.2)	75014	NC	1.0	0.00	0.0020	4.0E-05	8.7	0.017	3.5E-04	21	0.042	8.4E-04	5.5E+11	0.20	0.20
Xylenes (total)	1330207	NC	4.2	0.00	10	70	20	200	1000	66	660	1000	*L	1000	1000
Barium (TC = 100)	7440393	NC	NA	0.0	2			69			100			100	
Beryllium	7440417	C	NA	0.0		0.0040			0.24			0.78			1000
Cadmium (TC = 1.0)	7440439	NC	NA	0.0	0.005			1.0			1.0			1.0	
Chromium (III)	16065381	NC	NA	0.0		40			1000			1000			1000
Copper	7440508	NC	NA	0.0		1.0			129			401			1000
Lead (TC = 5.0)	7439921	C	NA	0.0		0.015			5			5			5
Nickel	7440020	NC	NA	0.0	0.1			21			80			1000	
Silver (TC = 5.0)	7440224	NC	NA	0.0		0.20			5.0			5.0			5.0
Vanadium	7440622	NC	NA	0.0		0.30			82			268			1000
Zinc	7440666	NC	NA	0.0		10			1000			1000			1000
Antimony	7440360	NC	NA	0.0	0.006	0.014	836	5.0	12	3330	20	47	*L	1000	1000
Arsenic (TC = 5.0)	7440382	C	NA	0.0	0.05	5.68E-05	590	5.0	0.034	2100	5.0	0.12	*T	5.0	5.0
Chromium (VI) (TC = 5.0)	7440473	NC	NA	0.0	0.1	0.175	406	5.0	5.0	1450	5.0	5.0	*T	5.0	5.0
Mercury (TC = 0.2)	7439976	NC	NA	0.0	0.002	0.011	414	0.20	0.20	1590	0.20	0.20	*T	0.20	0.20
Selenium (TC = 1.0)	7782492	NC	NA	0.0	0.05	0.175	110	1.0	1.0	383	1.0	1.0	*T	1.0	1.0
Thallium	7440280	NC	NA	0.0	0.002		1470	2.9		6430	13		*L	1000	

Draft LCTVs for Land Application Units

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Acenaphthene	83329	NC	16.0	0.00		2.0	1.5		3.0
Acetone (2-propanone)	67641	NC	1.0	0.00		4.0	1.5		6.0
Acetonitrile (methyl cyanide)	75058	NC	1.0	8.23E-07		0.20	1.5		0.30
Acetophenone	98862	NC	1.0	0.00		4.0	1.5		6.0
Acrolein	107028	NC	1.0	1.9E+08		0.70	*		1000
Acrylamide	79061	C	1.0	0.0052		2.0E-05	2.1		4.2E-05
Acrylonitrile (degrades to Acrylamide)	107131	C	1.0	0.00012		2.0E-04	1.7		4.2E-05
Aldrin	309002	C	4025	0.00		5.0E-06	4960		0.025
Aniline (benzeneamine)	62533	C	1.0	0.00		0.010	1.7		0.017
Benz[a]anthracene	56553	C	583	0.00		7.7E-05	2.9		2.2E-04
Benzene (TC = 0.5)	71432	C	1.2	0.00	0.0050	0.0030	1.7	0.0085	0.0051
Benzidine	92875	C	1.0	0.00		4.0E-07	1.7		6.8E-07
Benzo[a]pyrene	50328	C	1678	0.00	2.0E-04	1.0E-05	23	0.0046	2.3E-04
Benzo[b]fluoranthene	205992	NC	1678	0.00		7.1E-05	23		0.0016
Benzyl alcohol	100516	NC	1.0	0.00		10	1.5		15
Benzyl chloride (degrades to Benzyl alcohol)	100447	C	2.8	119		5.0E-04	*		15
Bis(2-chloroethyl)ether (degrades to 1,4-Dioxane)	111444	C	1.0	0.067		8.0E-05	5.3		4.2E-04
Bis(2-chloroisopropyl)ether	39638329	C	1.7	0.00		0.0010	1.7		0.0017
Bis(2-ethylhexyl)phthalate	117817	C	35864	7.15E-10	0.0060	0.0060	4.2E+22	1000	1000
Bromodichloromethane	75274	C	1.2	0.00079	0.080	0.0014	1.8	0.14	0.0025
Bromomethane (degrades to Methanol)	74839	NC	1.0	2.7		0.050	1.6E+06		30
Butanol	71363	NC	1.0	0.00		4.0	1.5		6.0
Butyl-4,6-dinitrophenol,2-sec-(Dinoseb)	88857	NC	1.3	0.00	0.0070	0.040	1.5	0.011	0.060
Butyl benzyl phthalate	85687	NC	46.1	4.76E-05		7.0	1.6		11
Carbon disulfide	75150	NC	1.2	0.00049		4.0	1.5		6.0
Carbon tetrachloride (TC = 0.5)	56235	C	1.7	0.0049	0.0050	7.0E-04	2.1	0.011	0.0015
Chlordane (TC = 0.03)	57749	C	2065	3.34E-10	0.0020	7.0E-05	56	0.030	0.0039
Chloro-1,3-butadiene 2-(Chloroprene)	126998	NC	1.1	0.00		0.70	1.5		1.1
Chloroaniline p-	106478	NC	1.1	0.00		0.10	1.5		0.15
Chlorobenzene (TC = 100)	108907	NC	2.0	0.00	0.10	0.70	1.5	0.15	1.1
Chlorobenzilate	510156	C	30.2	0.0017		3.0E-04	4.0		0.0012
Chlorodibromomethane	124481	C	1.2	0.00038	0.080	0.0010	1.7	0.14	0.0017
Chloroform (TC = 6.0)	67663	C	1.1	7.46E-05	0.080	0.010	1.7	0.14	0.017
Chloromethane	74873	C	1.0	0.00		6.6E-03	1.7		0.011
Chlorophenol 2-	95578	NC	1.2	0.00		0.20	1.5		0.30
Chloropropene, 3- (Allyl Chloride)	107051	NC	1.0	12		1.75	*		1000
Chrysene	218019	NC	583	0.00		0.0027	2.9		0.0078
Cresol m- (TC = 200)	108394	NC	1.2	0.00		2.0	1.5		3.0
Cresol o- (TC = 200)	95487	NC	1.2	0.00		2.0	1.5		3.0
Cresol p- (TC = 200)	106445	NC	1.2	0.00		0.20	1.5		0.30
Cumene	98828	NC	7.7	0.00		1.0	1.5		1.5
DDD	72548	C	2065	0.0073		4.0E-04	*		1000
DDE	72559	C	11606	0.00		3.0E-04	1.0E+10		1000
DDT, p,p'- (degrades to DDE)	50293	C	10344	0.017		3.0E-04	*		1000
Di-n-butyl phthalate	84742	NC	63.3	3.47E-05		4.0	1.6		6.4
Di-n-octyl phthalate	117840	NC	105841	8.99E-08		0.70	4.7E+14		1000
Diallate	2303164	C	40.3	0.029		0.0010	2500		2.5
Dibenz[a,h]anthracene	53703	C	8804	0.00		1.1E-05	1.2E+08		1000
Dibromo-3-chloropropane 1,2-	96128	C	1.2	0.0029	2.0E-04	6.0E-05	1.9	3.8E-04	1.1E-04
Dichlorobenzene 1,2-	95501	NC	4.2	0.00	0.60	3.0	1.5	0.90	4.5
Dichlorobenzene 1,4- (TC = 7.5)	106467	C	4.0	0.00	0.075	0.0040	1.7	0.13	0.0068
Dichlorobenzidine 3,3'-	91941	C	6.6	0.00		2.0E-04	1.7		3.4E-04
Dichlorodifluoromethane (Freon 12)	75718	NC	1.4	0.00		7.0	1.5		11
Dichloroethane 1,1- (degrades to Vinyl chloride)	75343	C	1.1	0.0033		9.0E-04	1.9	0.0030	6.0E-05

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Dichloroethane 1,2- (TC = 0.5) (degrades to Vinyl chloride)	107062	C	1.0	0.0028	0.0050	9.0E-04	1.8	0.0030	6.0E-05
Dichloroethylene cis-1,2-	156592	NC	1.1	0.00	0.070	0.40	1.5	0.11	0.60
Dichloroethylene trans-1,2-	156605	NC	1.1	0.00	0.10	0.70	1.5	0.15	1.1
Dichloroethylene 1,1- (Vinylidene chloride) (TC = 0.7)	75354	C	1.2	0.00	0.0070	1.0E-04	1.7	0.012	1.7E-04
Dichlorophenol 2,4-	120832	NC	1.8	0.00		0.10	1.5		0.15
Dichlorophenoxyacetic acid 2,4-(2,4-D) (TC = 10)	94757	NC	1.0	0.00		0.40	1.5		0.60
Dichloropropane 1,2-	78875	C	1.1	0.013	0.0050	0.0010	2.2	0.011	0.0022
Dichloropropene 1,3-(mixture of isomers)	542756	C	1.1	0.00		5.0E-04	1.7		8.5E-04
Dichloropropene cis-1,3-	10061015	C	1.2	12		5.0E-04	*		1000
Dimethoate (degrades to Methanol)	60515	NC	1.0	0.57		0.0070	220		1.5
Dimethoxybenzidine 3,3'-	119904	C	1.1	0.00		0.0060	1.7		0.010
Dimethyl phthalate (degrades to Methanol)	131113	NC	1.0	0.032		400	2.8		30
Dimethylbenz[a]anthracene 7,12-	57976	NC	11606	0.00		3.0E-06	1.1E+10		1000
Dimethylbenzidine 3,3'-	119937	C	1.9	0.00		9.0E-06	1.7		1.5E-05
Dimethylphenol 2,4-	105679	NC	1.5	0.00		0.70	1.5		1.1
Dinitrobenzene 1,3-	99650	NC	1.1	0.00		0.0040	1.5		0.0060
Dinitrophenol 2,4-	51285	NC	1.0	0.00		0.070	1.5		0.11
Dinitrotoluene 2,4- (TC = 0.13)	121142	NC	1.1	0.00		0.070	1.5		0.11
Dinitrotoluene 2,6-	606202	NC	1.1	0.00		0.040	1.5		0.060
Dioxane 1,4-	123911	C	1.0	0.00		0.0080	1.7		0.014
Diphenylamine	122394	NC	6.3	0.00		0.90	1.5		1.4
Disulfoton	298044	NC	3.3	0.67		0.0010	3.6E+06		1000
Endosulfan (Endosulfan I and II, mixture)	115297	NC	10.4	0.64		0.20	5.5E+10		1000
Endrin (TC = 0.02)	72208	NC	107	0.016	0.0020	0.010	8.1E+04	0.020	0.020
Epichlorohydrin	106898	C	1.0	9.0		0.0090	*		1000
Ethoxyethanol 2-	110805	NC	1.0	0.00		10	1.5		15
Ethyl acetate	141786	NC	1.0	0.063		30	4.1		123
Ethyl ether	60297	NC	1.0	0.00		7.0	1.5		11
Ethyl methacrylate	97632	NC	1.0	0.019		3.0	2.3		6.9
Ethyl methanesulfonate	62500	C	1.0	363		3.0E-07	*		1000
Ethylbenzene	100414	NC	3.7	0.00	0.70	4.0	1.5	1.1	6.0
Ethylene dibromide (1,2-Dibromoethane)	106934	C	1.1	0.18	5.0E-05	1.0E-06	15	7.7E-04	1.5E-05
Ethylene thiourea	96457	C	1.0	0.00		2.0E-05	1.7		3.5E-05
Fluoranthene	206440	NC	114	0.00		1.0	1.7		1.7
Fluorene	86737	NC	22.6	0.00		1.0	1.5		1.5
Formaldehyde	50000	NC	1.0	0.00		7.0	1.5		11
Formic acid	64186	NC	1.0	0.00		70	1.5		105
Furan	110009	NC	1.0	0.00		0.040	1.5		0.060
HCH beta-	319857	C	8.2	0.00		5.0E-05	1.7		8.5E-05
HCH (Lindane) gamma- (TC = 0.4) (degrades to 1,2,4-Trichlorobenzene)	58899	C	7.7	0.31	2.0E-04	7.0E-05	3.0E+05	0.11	0.40
HCH alpha- (degrades to 1,2,4-Trichlorobenzene)	319846	C	8.2	0.31		1.0E-05	4.9E+05	0.11	0.60
Heptachlor (TC = 0.008)	76448	C	432	18	4.0E-04	2.0E-05	*	0.0080	0.0080
Heptachlor epoxide	1024573	C	212	0.018	2.0E-04	9.0E-06	2.9E+07	1000	265
Hexachloro-1,3-butadiene (TC = 0.5)	87683	C	77.7	0.00		0.0010	1.8		0.0018
Hexachlorobenzene (TC = 0.13)	118741	C	686	0.00	0.0010	5.0E-05	3.6	0.0036	1.8E-04
Hexachlorocyclopentadiene	77474	NC	141	7.2	0.050	0.30	*	1000	1000
Hexachloroethane (TC = 3.0)	67721	C	11.8	0.00		0.0060	1.7		0.010
Hexachlorophene	70304	NC	267	0.00		0.010	2.0		0.020
Indeno[1,2,3-cd]pyrene	193395	C	4839	0.00		2.1E-04	4.4E+04		9.2
Isobutyl alcohol	78831	NC	1.0	0.00		10	1.5		15
Isophorone	78591	C	1.2	0.00		0.090	1.7		0.15
Kepone	143500	C	38.6	0.00		2.0E-06	1.8		3.6E-06
Methacrylonitrile	126987	NC	1.0	0.00012		0.0040	1.5		0.0060
Methanol	67561	NC	1.0	0.00		20	1.5		30

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Methoxychlor (TC = 10.0)	72435	NC	212	0.20	0.040	0.20	*	10	10
Methyl ethyl ketone (TC = 200)	78933	NC	1.0	0.00		20	1.5		30
Methyl isobutyl ketone	108101	NC	1.0	0.00		2.0	1.5		3.0
Methyl methacrylate (degrades to Methanol)	80626	NC	1.0	0.034		3.0	2.7		8.1
Methyl parathion (degrades to Methanol)	298000	NC	1.8	0.81		0.0090	8.2E+04		30
Methylcholanthrene 3-	56495	C	26587	0.00		3.0E-06	2.6E+19		1000
Methylene bromide (Dibromomethane)	74953	NC	1.0	0.00		0.40	1.5		0.60
Methylene Chloride (Dichloromethane) (degrades to Formaldehyde)	75092	C	1.0	0.00029	0.0050	0.010	1.7	0.0085	0.017
N-Nitroso-di-n-butylamine	924163	C	1.3	0.00		2.0E-05	1.7		3.4E-05
N-Nitroso-di-n-propylamine	621647	C	1.0	0.00		1.0E-05	1.7		1.7E-05
N-Nitrosodiethylamine	55185	C	1.0	0.00		6.0E-07	1.7		1.0E-06
N-Nitrosodimethylamine	62759	C	1.0	0.00		2.0E-06	1.7		3.4E-06
N-Nitrosodiphenylamine	86306	C	2.8	0.00		0.020	1.7		0.034
N-Nitrosomethylethylamine	10595956	C	1.0	0.00		4.0E-06	1.7		6.8E-06
N-Nitrosopiperidine	100754	C	1.0	0.00		2.0E-06	1.7		3.4E-06
N-Nitrosopyrrolidine	930552	C	1.0	0.00		4.0E-05	1.7		6.8E-05
Naphthalene	91203	NC	4.4	0.00		1.0	1.5		1.5
Nitrobenzene (TC = 2.0)	98953	NC	1.1	0.00		0.020	1.5		0.030
Octamethyl pyrophosphoramidate	152169	NC	1.0	8.80E-05		0.070	1.5		0.11
Parathion (ethyl)	56382	NC	4.8	0.71		0.20	2.6E+07		1000
Pentachlorobenzene	608935	NC	654	0.00		0.030	3.4		0.10
Pentachloronitrobenzene (PCNB)	82688	C	100	0.00		3.0E-04	1.8		5.4E-04
Pentachlorophenol (TC = 100)	87865	C	4.1	0.00	0.0010	7.0E-04	1.7	0.0017	0.0012
Polychlorinated biphenyls (Aroclors)	1336363	C	4119	0.00	5.0E-04	1.0E-05	6693	3.3	0.067
Pronamide	23950585	NC	2.1	2.09E-05		3.0	1.5		4.5
Pyrene	129000	NC	222	0.00		1.0	1.9		1.9
Pyridine (TC = 5.0)	110861	NC	1.0	0.00		0.040	1.5		0.060
Safrole	94597	C	1.6	0.00		5.0E-04	1.7		8.5E-04
Strychnine and salts	57249	NC	1.2	0.00		0.010	1.5		0.015
Styrene	100425	NC	2.8	0.00	0.10	7.0	1.5	0.15	11
TCDDioxin 2, 3, 7, 8-	1746016	C	3348	0.00	3.0E-08	6.0E-10	895	2.7E-05	5.4E-07
Tetrachlorobenzene 1,2,4,5-	95943	NC	52.1	0.00		0.010	1.6		0.016
Tetrachloroethane 1,1,1,2- (degrades to Trichloroethylene)	630206	C	2.4	0.0041		0.0030	2.2	0.0085	0.0066
Tetrachloroethane 1,1,2,2- (degrades to Trichloroethylene)	79345	C	1.3	0.22		4.0E-04	35	0.0085	0.014
Tetrachloroethylene (TC = 0.7)	127184	NC	1.4	0.00	0.0050	0.40	1.5	0.0075	0.60
Tetrachlorophenol 2,3,4,6-	58902	NC	1.6	0.00		1.0	1.5		1.5
Tetraethyl dithiopyrophosphate (Sulfotep)	3689245	NC	9.6	24		0.020	*		1000
Toluene	108883	NC	1.7	0.00	1.0	7.0	1.5	1.5	11
Toluenediamine 2,4-	95807	C	1.0	0.00		3.0E-05	1.7		5.1E-05
Toluidine o-	95534	C	1.0	0.00		4.0E-04	1.7		6.8E-04
Toluidine p-	106490	C	1.0	0.00		4.0E-04	1.7		6.8E-04
Toxaphene (chlorinated camphenes) (TC = 0.5)	8001352	C	55.3	0.020	0.0030	8.0E-05	2200	0.50	0.18
Tribromomethane (Bromoform)	75252	C	1.3	0.00014	0.10		1.7	0.17	
Trichloro-1,2,2-trifluoro-ethane 1,1,2-	76131	NC	3.5	0.00		1000	1.5		1000
Trichlorobenzene 1,2,4-	120821	NC	25.2	0.00	0.070	0.40	1.5	0.11	0.60
Trichloroethane 1,1,1-	71556	NC	1.4	0.22	0.20		42	8.4	
Trichloroethane 1,1,2- (degrades to 1,1-Dichloroethylene)	79005	C	1.1	0.00080	0.0050	0.0010	1.8	0.0090	1.7E-04
Trichloroethylene (1,1,2-Trichloroethylene) (TC = 0.5)	79016	C	1.3	0.00	0.0050	0.0080	1.7	0.0085	0.014
Trichlorofluoromethane (Freon 11)	75694	NC	1.3	0.00		10	1.5		15
Trichlorophenol 2,4,5- (TC = 400)	95954	NC	3.3	0.00		4.0	1.5		6.0
Trichlorophenol 2,4,6- (TC = 2.0)	88062	C	1.5	0.00		0.0080	1.7		0.014

Common Name	CAS#	C?	R	λ (yr-1)	MCL (mg/L)	HBN (mg/L)	No Liner/In-Situ Soil		
							DAF	LCTV based on MCL (mg/L)	LCTV based on HBN (mg/L)
Trichlorophenoxypropionic acid 2-(2,4,5- (Silvex) (TC = 1.0)	93721	NC	1.1	0.00		0.30	1.5		0.45
Trichlorophenoxyacetic acid 2,4,5-	93765	NC	1.1	0.00		0.40	1.5		0.60
Trichloropropane 1,2,3-	96184	NC	1.1	0.0050		0.20	1.7		0.34
Trinitrobenzene, sym- (1,3,5- Trinitrobenzene)	99354	NC	1.0	0.00		0.0020	1.5		0.0030
Tris(2,3-dibromopropyl)phosphate	126727	C	5.1	0.027		9.0E-06	15		1.4E-04
Vinyl chloride (TC = 0.2)	75014	NC	1.0	0.00	0.0020	4.0E-05	1.5	0.0030	6.0E-05
Xylenes (total)	1330207	NC	4.2	0.00	10	70	1.5	15	105
Antimony	7440360	NC	NA	NA	0.006	0.014	89	0.54	1.2
Arsenic (TC = 5.0)	7440382	C	NA	NA	0.05	5.68E-05	67	3.3	0.0038
Chromium (VI) (TC = 5.0)	7440473	NC	NA	NA	0.1	0.175	45	4.5	5.0
Mercury (TC = 0.2)	7439976	NC	NA	NA	0.002	0.011	34	0.068	0.20
Selenium (TC = 1.0)	7782492	NC	NA	NA	0.05	0.175	11	0.56	1.0
Thallium	7440280	NC	NA	NA	0.002		155	0.31	
Barium (TC = 100)	7440393	NC	NA	NA	2			8.0	
Beryllium	7440417	C	NA	NA		0.0040			0.022
Cadmium (TC = 1.0)	7440439	NC	NA	NA	0.005			0.11	
Chromium (III)	16065381	NC	NA	NA		40			1000
Copper	7440508	NC	NA	NA		1.0			36
Lead (TC = 5.0)	7439921	C	NA	NA		0.015			5
Nickel	7440020	NC	NA	NA	0.1			1.7	
Silver (TC = 5.0)	7440224	NC	NA	NA		0.20			1.0
Vanadium	7440622	NC	NA	NA		0.30			35
Zinc	7440666	NC	NA	NA		10			124

DESIGNING AND INSTALLING LINERS SECTION
APPENDIX

Technical Considerations for Surface Impoundments,
Landfills, and Waste Piles

Appendix I: Materials Commonly Used as Alternatives to Soil in Waste Management Unit Designs

Alternative materials typically refer to geosynthetics, which include geotextiles, geogrids, geonets, geomembranes, geosynthetic clay liners, and geocomposites. Geosynthetics are typically incorporated into liner designs to perform one or more of five major functions including separation, reinforcement, filtration, drainage, and liquid barrier. For almost all geosynthetics, some of the construction properties to be concerned with include installation damage, stress cracking, and degradation, as a result of temperature, chemical interaction, or ultraviolet radiation.

Since geomembranes and geosynthetic clay liners are described in detail earlier in the section on liner types, they are not included in this appendix. The remaining four materials, geotextiles, geogrids, geonets, and geocomposites, and their functions, are described briefly below.

Geotextiles. Geotextiles refer to a permeable layer comprised of textile material, often available as a nonwoven fabric, a knitted fabric, or a woven fabric. Since the fabric is a synthetic material and not a natural fiber, such as cotton or wool, biodegradation is not a major concern. However, other physical properties that may need to be specified for a manufacturer include specific gravity, mass per unit area, thickness, and stiffness. Additionally, designers using geotextiles should consider how the geotextile behaves with respect to tensile stresses, including properties such as compressibility, tensile strength, seam strength, fatigue strength, and tear and puncture resistance. Geotextiles may be used to perform any of the five functions, depending on the type of geotextile selected.

Geogrids. Geogrids are plastic pieces manufactured into an open, gridlike configuration and are typically used as reinforcement. They are designed with apertures or openings sized to allow strike through of surrounding rock and soil. Typical opening sizes range from 1 to 10 cm (0.5 to 4 in.). Some of the design properties to be concerned with for geogrids include single rib and junction or node strength, wide width tensile strength, shear strength, and anchorage strength.

Geonets. Geonets consist of integrally connected parallel sets of plastic ribs overlying similar sets at various angles. Geonets are typically used as part of a drainage system. Some of the design considerations for geonets include tensile strength, compressive strength, intrinsic shear strength, and hydraulic properties including planar flow, also known as transmissivity.

Geocomposites. Geocomposites are manufactured products consisting of two or more types of geosynthetics, such as geonets, geogrids, geotextiles, or geomembranes, produced in either laminated or composite form. Owners and operators will be concerned with different design considerations depending on which types of geosynthetic materials are combined to make the geocomposite.

DESIGNING A LAND APPLICATION PROGRAM
APPENDICES

Appendix I: State Cooperative Agricultural Extension Services

ALABAMA

Alabama Cooperative Extension System
109-D Duncan Hall
Auburn University, AL 36849
Phone: 334 844-4444
E-mail: sjones@acesag.auburn.edu
Internet: www.acesag.auburn.edu

ALASKA

Alaska Cooperative Extension
University of Alaska Fairbanks
Arctic Health Research Building
PO Box 756180
Fairbanks, AK 99775
Phone: 907 474-7246 Fax: 907 474-6567
E-mail: ffhdh@aurora.alaska.edu
Internet: zorba.uafadm.alaska.edu/coop-ext/index.html

ARIZONA

Arizona Cooperative Extension Service
301 Forbes Building
Tucson, AZ 85721
Phone: 602 621-7209 Fax: 602 621-1314
E-mail: jimc@ag.arizona.edu
Internet: ag.arizona.edu/ext/coopext.html

ARKANSAS

University of Arkansas Cooperative
Extension Service
P.O. Box 391
Little Rock, AR 72203
Phone: 501 671-2117 Fax: 501 671-2121
E-mail: lsmith@uaex.edu
Internet: www.uaex.edu

CALIFORNIA

University of California Cooperative
Extension
Internet: danr.ucop.edu/uccelr/uccelr.htm

When contacting in person, by mail, or by
phone/fax, contact regional offices.

CALIFORNIA, NORTHERN REGION

University of California Cooperative
Extension
DANR Building
Hopkins Road
Davis, CA 95616
Phone: 916 754-8491 Fax: 916 754-8499
Internet: www.ucce-north.ucdavis.edu

CALIFORNIA, NORTH CENTRAL REGION

University of California
DANR Services Building
Hopkins Road
Davis, CA 95616
Phone: 916 754-8509 Fax: 916 754-8540
Internet: www.ncr.ucdavis.edu

CALIFORNIA, SOUTH REGION

University of California
Division of Agriculture and Natural
Resources, Southern Region
University of California, Riverside
Riverside, CA 92521
Phone: 909 787-3321
Internet: uccesouth.ucr.edu

CALIFORNIA, SOUTH CENTRAL REGION

University of California
Kearney Agricultural Center
9240 S. Riverbend Avenue
Parlier, CA 93648
Phone: 209 646-6500 Fax: 206 646-6513
E-mail: ccrabb@uckac.edu
Internet: www.uckac.edu/danrscr

Appendix I: State Cooperative Agricultural Extension Services (cont.)

COLORADO

Colorado State University Cooperative
Extension
1 Administration Building
Colorado State University
Fort Collins, CO 80523
Phone: 970 491-6281 Fax: 970 491-6208
E-mail: mrewerts@vines.colostate.edu
Internet: www.colostate.edu/depts/coopext

CONNECTICUT

Cooperative Extension System
205 Young Building
1376 Storrs Road
Storrs, CT 6269
Phone: 860 486-6271 Fax: 860 486-4128
Internet: www.lib.uconn.edu/canr/ces

DELAWARE

Delaware Cooperative Extension
Townsend Hall
University of Delaware
Newark, DE 19717
Phone: 302 831-2501
E-mail: nye@udel.edu
Internet: bluehen.ags.udel.edu/deces

FLORIDA

Florida Cooperative Extension Service
Institute of Food and Agricultural Sciences
University of Florida
Gainesville, FL 32611
Internet: www.ifas.ufl.edu/www/agator/html/ces.htm

GEORGIA

University of Georgia Cooperative Extension
Service
Hoke Smith Building
The University of Georgia
Athens, GA 30602
Phone: 706 542-3824 Fax: 706 542-8815
Internet: www.ces.uga.edu

HAWAII

University of Hawaii
College of Tropical Agriculture and Human
Resources
Gilmore 202
3050 Maile Way
Honolulu, HI 96822
Phone: 808 956-8234 Fax: 808 956-9105
Internet: www.hawaii.edu/catalog/ctahr.html

IDAHO

University of Idaho Cooperative Extension
System
Agricultural Sciences Building, Room 51
Moscow, ID 83844
Phone: 208 885-6639 Fax: 208 885-6654
E-mail: extdir@uidaho.edu
Internet: www.uidaho.edu/ag/extension

ILLINOIS

Illinois Cooperative Extension Service
338 Agricultural Engineering Sciences
Building
1304 W. Pennsylvania Avenue
Urbana, IL 61801
Phone: 217 333-3570 Fax: 217 244-0323
E-mail: age@uiuc.edu
Internet: www.ag.uiuc.edu

INDIANA

Purdue University Cooperative Extension
Service
1140 AGAD Building
West Lafayette, IN 47907
Phone: 765 494-8489 Fax: 765 494-5876
E-mail: Henry_Wadsworth@ces.purdue.edu
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Appendix I: State Cooperative Agricultural Extension Services (cont.)

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15 BDSHR
Ames, IA 50011
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E-mail: vpforext@exnet.iastate.edu
Internet: [<www.exnet.iastate.edu>](http://www.exnet.iastate.edu)

KANSAS

Kansas State University Research and
Extension
114 Waters Hall
Manhattan, KS 66506
Phone: 913 532-6147
E-mail: mjohnson@oz.oznet.ksu.edu
Internet: [<www.oznet.ksu.edu>](http://www.oznet.ksu.edu)

KENTUCKY

University of Kentucky University
Extension
Frazee Hall
University of Kentucky
Lexington, KY 40506
Phone: 800 432-0963
Internet: [<www.ca.uky.edu>](http://www.ca.uky.edu)

LOUISIANA

Louisiana Cooperative Extension Service
Knapp Hall
P.O. Box 25100
Baton Rouge, LA 70894
Phone: 504 388-4141 Fax: 504 388-2467
Internet: [<130.39.57.11/wwwac/lces.html>](http://130.39.57.11/wwwac/lces.html)

MAINE

University of Maine Cooperative Extension
102 Libby Hall
Orono, ME 4469
Phone: 800 287-0274 Fax: 207 581-1387
E-mail: lbartel@umce.umext.maine.edu
Internet: [<www.umext.maine.edu>](http://www.umext.maine.edu)

MARYLAND

University of Maryland Extension Service
UMES Cooperative Extension Programs
2122 The Richard A. Henson Center
Princess Anne, MD 21853
Phone: 410 651-6206 Fax: 410 651-6207
E-mail: hbrooks@umes-bird.umd.edu
Internet: [<www.agnr.umd.edu/ces>](http://www.agnr.umd.edu/ces)

MASSACHUSETTS

University of Massachusetts Extension
Program
Stockbridge Hall, Box 3723C
University of Massachusetts
Amherst, MA 1003
Phone: 413 545-2766 Fax: 413 545-1242
E-mail: umext@umext.umass.edu
Internet: [<www.umass.edu/umext>](http://www.umass.edu/umext)

MICHIGAN

Michigan State University Extension
108 Agriculture Hall
East Lansing, MI 48824
Phone: 517 355-2308 Fax: 517 355-6473
E-mail: msue@msue.msu.edu
Internet: [<www.msue.msu.edu>](http://www.msue.msu.edu)

MINNESOTA

Minnesota Extension Service
University of Minnesota
240 Coffey Hall, 1420 Eckles Ave.
St. Paul, MN 55108
Phone: 612 624-1222 Fax: 612 625-6227
E-mail: info@mes.umn.edu
Internet: [<www.mes.umn.edu>](http://www.mes.umn.edu)

MISSISSIPPI

Mississippi Cooperative Extension Service
201 Bost Extension Center
Mississippi State, MS 39762
Phone: 601 325-3036 Fax: 601 325-8407
E-mail: brown@ces.msstate.edu
Internet: [<www.ces.msstate.edu>](http://www.ces.msstate.edu)

Appendix I: State Cooperative Agricultural Extension Services (cont.)

MISSOURI

University of Missouri Extension
309 University Hall
Columbia, MO 65211
Phone: 573 882-7754
E-mail: turnerr@ext.missouri.edu
Internet: [<extension.missouri.edu>](http://extension.missouri.edu)

MONTANA

University of Montana Extension Service
P.O. Box 172560
Bozeman, MT 59717
Phone: 406 994-4371
Internet: [<www.montana.edu/~wwwcx/index.html>](http://www.montana.edu/~wwwcx/index.html)

NEBRASKA

University of Nebraska Cooperative Extension
211 Agricultural Hall
University of Nebraska-Lincoln
Lincoln, NE 68583
Phone: 402 472-2966
E-mail: coex005@unlvm.unl.edu
Internet: [<ianrwww.unl.edu/ianr/coopext/coopext.htm>](http://ianrwww.unl.edu/ianr/coopext/coopext.htm)

NEVADA

Nevada Agricultural Experiment Station
University of Nevada, Reno
Director's Office/221
Reno, NV 89557
Phone: 702 784-1610 Fax: 702 784-6604
E-mail: robbins@fs.scs.unr.edu
Internet: [<www.unr.edu/naes>](http://www.unr.edu/naes)

NEW HAMPSHIRE

University of NH Cooperative Extension
59 College Road
Taylor Hall
Durham, NH 3824
Phone: 603 862-1520 Fax: 603 862-1585
Internet: [<ceinfo.unh.edu>](http://ceinfo.unh.edu)

NEW JERSEY

Rutgers Cooperative Extension
Cook College
P.O. Box 231
New Brunswick, NJ 8903
Phone: 908 932-9306 Fax: 908 932-6633
E-mail: rceinfo@aesop.rutgers.edu
Internet: [<www.rce.rutgers.edu>](http://www.rce.rutgers.edu)

NEW MEXICO

Cooperative Extension Service
Gerald Thomas Hall, Room 220
New Mexico State University
Box 30003, Dept. 3AE
Las Cruces, NM 88003
Phone: 505 646-3015
E-mail: jschicke@nmsu.edu
Internet: [<www.cahe.nmsu.edu>](http://www.cahe.nmsu.edu)

NEW YORK

Cornell Cooperative Extension
276 Roberts Hall
Cornell University
Ithaca, NY 14853
Phone: 607 255-2237 Fax: 607 255-2473
E-mail: cedir@cce.cornell.edu
Internet: [<www.cce.cornell.edu>](http://www.cce.cornell.edu)

NORTH CAROLINA

Cooperative Extension Service
112 Patterson, Box 7601
North Carolina State University
Raleigh, NC 27695
Phone: 919 515-2811 Fax: 919 515-6980
E-mail: durward_bateman@ncsu.edu
Internet: [<www.ces.ncsu.edu>](http://www.ces.ncsu.edu)

NORTH DAKOTA

North Dakota State University Extension Service
Morrill Hall 315
North Dakota State University
Fargo, ND 58105
Phone: 701 231-8944 Fax: 701 231-8520
E-mail: ext-dir@ndsuent.nodak.edu
Internet: [<www.ext.nodak.edu>](http://www.ext.nodak.edu)

Appendix I: State Cooperative Agricultural Extension Services (cont.)

OHIO

Ohio State University Extension
3 Agricultural Administration Building
2120 Fyffe Road
Columbus, OH 43210
Phone: 614 292-6181
E-mail: smith@agvax2.ag.ohio-state.edu
Internet: [<www.ag.ohio-state.edu>](http://www.ag.ohio-state.edu)

OKLAHOMA

Oklahoma Cooperative Extension Service
Oklahoma State University
139 Agricultural Hall
Stillwater, OK 74078
Phone: 405 744-5398 Fax: 405 744-5339
E-mail: raycam@okway.okstate.edu
Internet: [<bubba.ucc.okstate.edu/osu_ag/oces>](http://bubba.ucc.okstate.edu/osu_ag/oces)

OREGON

Oregon State University Extension Service
Oregon State University
422 Kerr Administration Building
Corvallis, OR 97331
Phone: 541 737-0804
Internet: [<www.wagcomm.ads.orst.edu/agcomwebfile/extser>](http://www.wagcomm.ads.orst.edu/agcomwebfile/extser)

PENNSYLVANIA

Cooperative Extension Service
201 Agricultural Administration Building
The Pennsylvania State University
University Park, PA 16802
Fax: 814 865-3103
E-mail: oce@psu.edu
Internet: [<www.cas.psu.edu/docs/coext/coopext.html>](http://www.cas.psu.edu/docs/coext/coopext.html)

RHODE ISLAND

University of Rhode Island Cooperative
Extension Service
9 East Alumni Avenue, Suite 5
Kingston, RI 02881
Internet: [<www.edc.uri.edu>](http://www.edc.uri.edu)

SOUTH CAROLINA

Clemson University Cooperative Extension
Service
103 Barre Hall
Clemson University
Clemson, SC 29634
Phone: 864 656-3382 Fax: 864 656-0765
Internet: [<agweb.clemson.edu/exten/home.htm>](http://agweb.clemson.edu/exten/home.htm)

SOUTH DAKOTA

South Dakota Cooperative Extension
Service
Ag Hall 152E, Box 2207D
South Dakota State University
Brookings, SD 57007
Phone: 605 688-4792
Internet: [<www.abs.sdstate.edu/ces>](http://www.abs.sdstate.edu/ces)

TENNESSEE

University of Tennessee Extension Service
The University of Tennessee
P.O. Box 1071
Knoxville, TN 37901
Phone: 423 974-7114
Internet: [<funnelweb.utcc.utk.edu/~utext>](http://funnelweb.utcc.utk.edu/~utext)

TEXAS

Texas Agricultural Extension Service
104 Administration
College Station, TX 77843
Phone: 409 845-7800 Fax: 409 845-9542
Internet: [<leviathan.tamu.edu>](http://leviathan.tamu.edu)

UTAH

Utah State University Extension
Utah State University
Logan, UT 84322
Phone: 801 797-2201
E-mail: bobg@ext.usu.edu
Internet: [<ext.usu.edu>](http://ext.usu.edu)

Appendix I: State Cooperative Agricultural Extension Services (cont.)

VERMONT

University of Vermont Extension
601 Main Street
University of Vermont
Burlington, VT 5401
Phone: 802 656-2980 Fax: 802 656-8642
E-mail: lforcier@zoo.uvm.edu
Internet: <ctr.uvm.edu/ext>

VIRGINIA

Virginia Cooperative Extension
104 Hutcheson
Virginia Polytechnic Institute & State
University
Blacksburg, VA 24061
Phone: 540 001-5299
Internet: <www.ext.vt.edu>

WASHINGTON

Washington State University Cooperative
Extension
College of Agriculture and Home
Economics
Washington State University
Pullman, WA 99164
Phone: 509 335-4561
Internet: <www.cahe.wsu.edu/ce.html>

WEST VIRGINIA

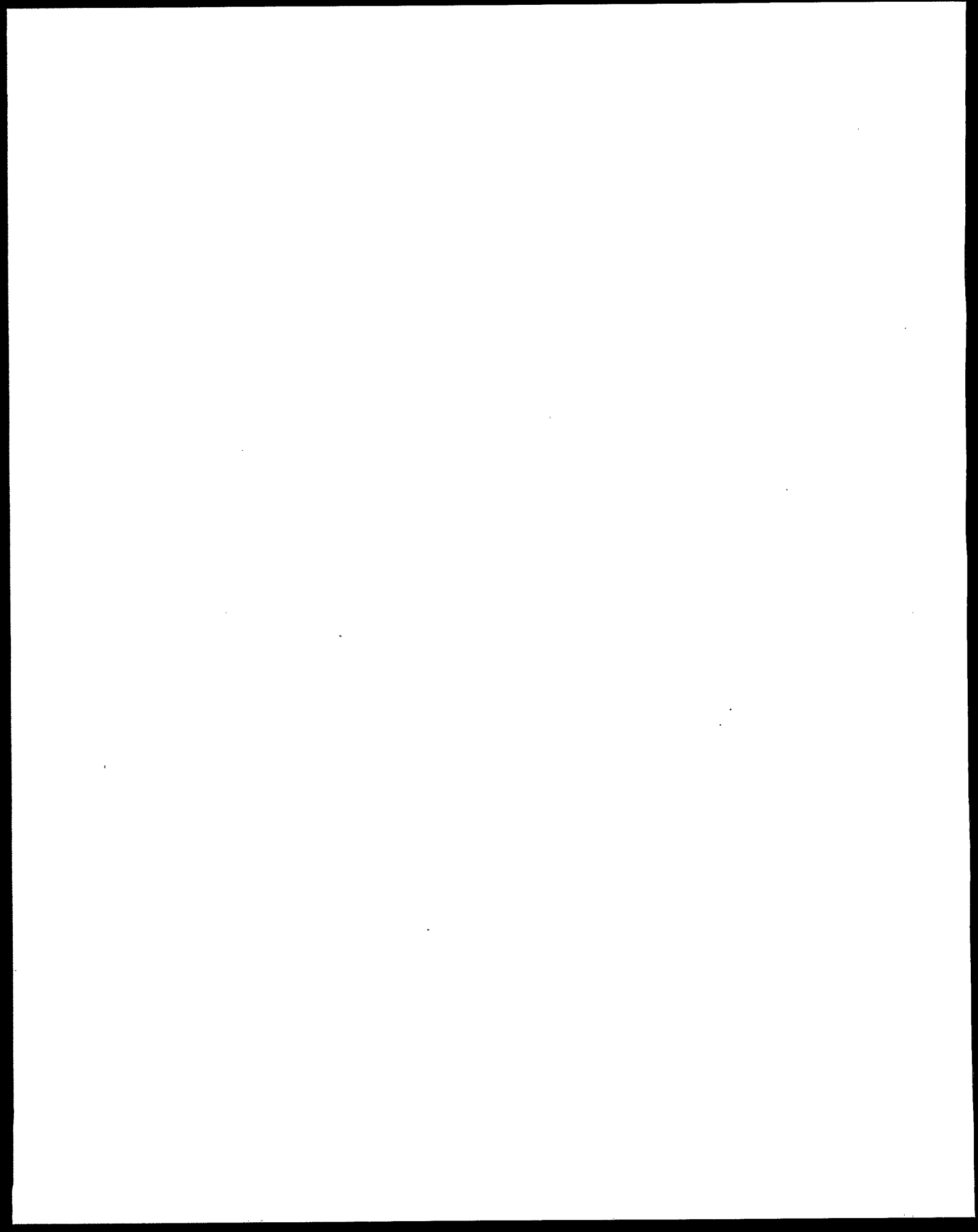
West Virginia University Extension Service
West Virginia University
Room 817 Knapp Hall, P.O. Box 6031
Morgantown, WV 26506
Phone: 304 293-5691 Fax: 304 293-7163
E-mail: lcote@wvu.edu
Internet: <www.wvu.edu/~exten>

WISCONSIN

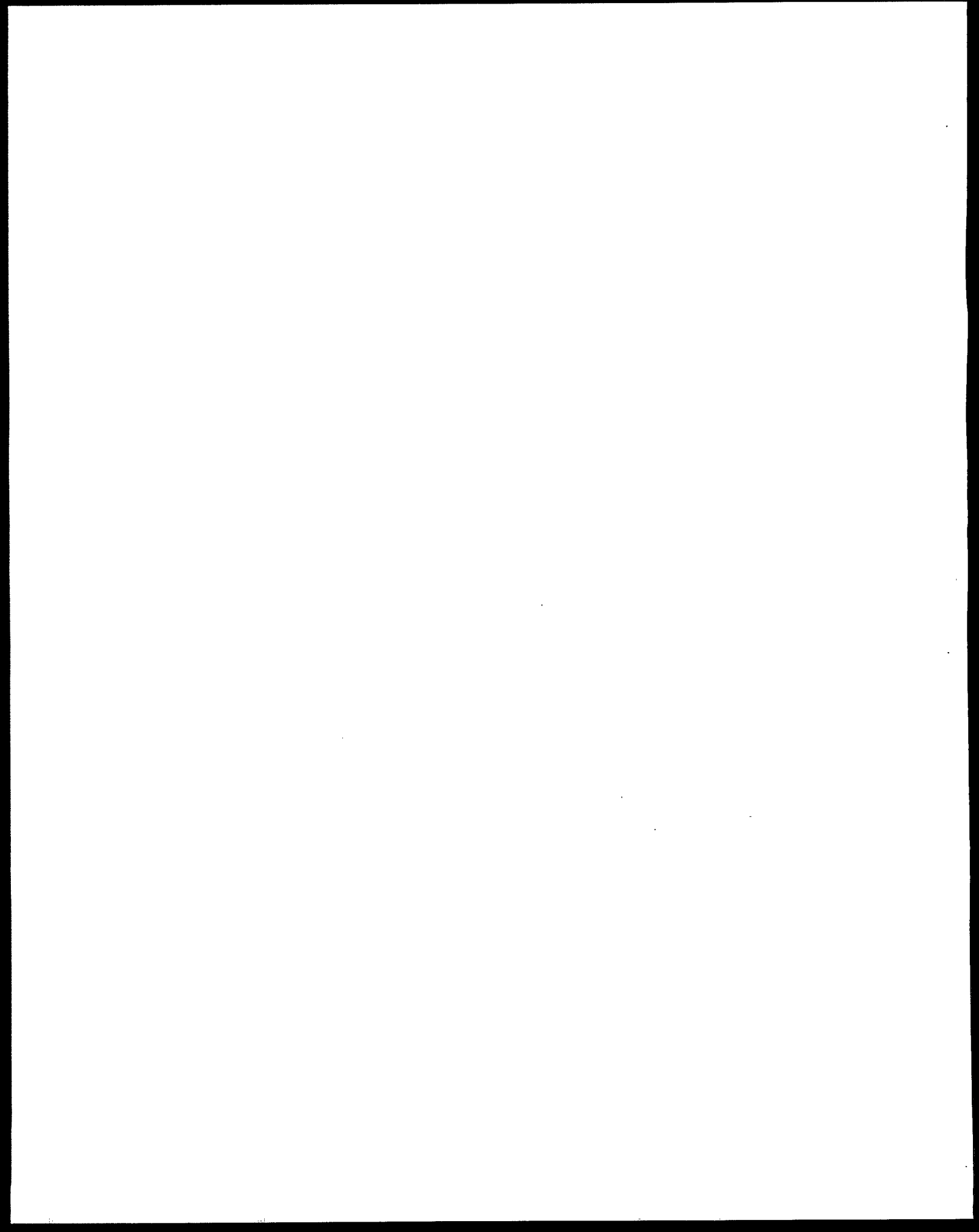
University of Wisconsin Cooperative
Extension
601 Extension Building
432 N. Lake Street
Madison, WI 53706
Phone: 608 263-5110
Internet: <www.uwex.edu/ces>

WYOMING

University of Wyoming Cooperative
Extension Service
P.O. Box 3354
Laramie, WY 82071
Phone: 307 766-5124 Fax: 307 766-3998
Internet: <www.uwyo.edu/ag/ces/
ceshome.htm>



OPERATING THE WASTE MANAGEMENT SYSTEM
APPENDICES



EPA/625/R-97/003
October 1997

ISO 14000 Resource Directory

U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory
Center for Environmental Research Information
Cincinnati, Ohio

DISCLAIMER

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described here under Contract #68-3-0315 to Eastern Research Group, Inc. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy implementation of environmental regulations and strategies.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients. This publication was developed jointly with the USEPA Standards Network, Office of Prevention, Pesticides and Toxic Substances.

This report, *ISO 14000 Resource Directory*, funded through the Center for Environmental Research Information, is a pollution prevention guide for government and nonprofit initiatives and projects related to the developing ISO 14000 series of Environmental Management Standards.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

ABSTRACT

This Directory provides information about current initiatives related to the developing ISO 14000 series of environmental standards. Interest in the standards among governments, nongovernmental organizations, industry and the public is high and expected to grow as the standards become finalized. A measure of this interest is the fact that even before the first of the ISO 14000 series standards was issued, over 100 government and nonprofit organizations submitted information for inclusion in this Directory. This number excludes the hundreds of private sector initiatives, not included in this Directory, that are also underway. The U.S. Technical Advisory Group (TAG) to ISO Technical Committee 207 (the ISO Committee developing the ISO 14000 series standards), for example, consists of hundreds of members from industry, government, consulting firms, nongovernmental organizations, and academia. Dozens of private sector organizations have emerged to offer training, consulting, and other services related to ISO 14000, while hundreds of individual companies are investigating ISO 14000 to determine its implications.

The ISO 14000 is a global series of standards developed outside regulatory channels that has the potential to revolutionize both the way industrial and other organizations manage environmental affairs, the way regulatory agencies relate to the regulated community, and the way customers and society at large relate to companies and other organizations. Whether this potential will be realized is not yet clear. Much will depend on how industry, governments, and nongovernmental organizations respond to, and use, the standards. If their potential is realized, the introduction of the ISO 14000 series standards could be one of the most significant environmental developments of our time.

This Directory is an effort by EPA to contribute to an understanding of the ISO 14000 series standards. It does not attempt to promote or discourage use of the standards. Rather, it is intended to facilitate communication among the many groups or individuals examining or using the standards. A useful first step in improving our understanding of the standards is to provide a forum where interested parties can communicate and learn from each others' experience.

The audience for this resource directory is anyone interested in the ISO 14000 series of International Environmental Standards. Companies from large to small and government at all levels could find the information contained in this directory useful.

This report was submitted in fulfillment of Contract #68-3-0315 by Eastern Research Group, Inc. under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from January, 1997 to May 31, 1997.

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NOTICE

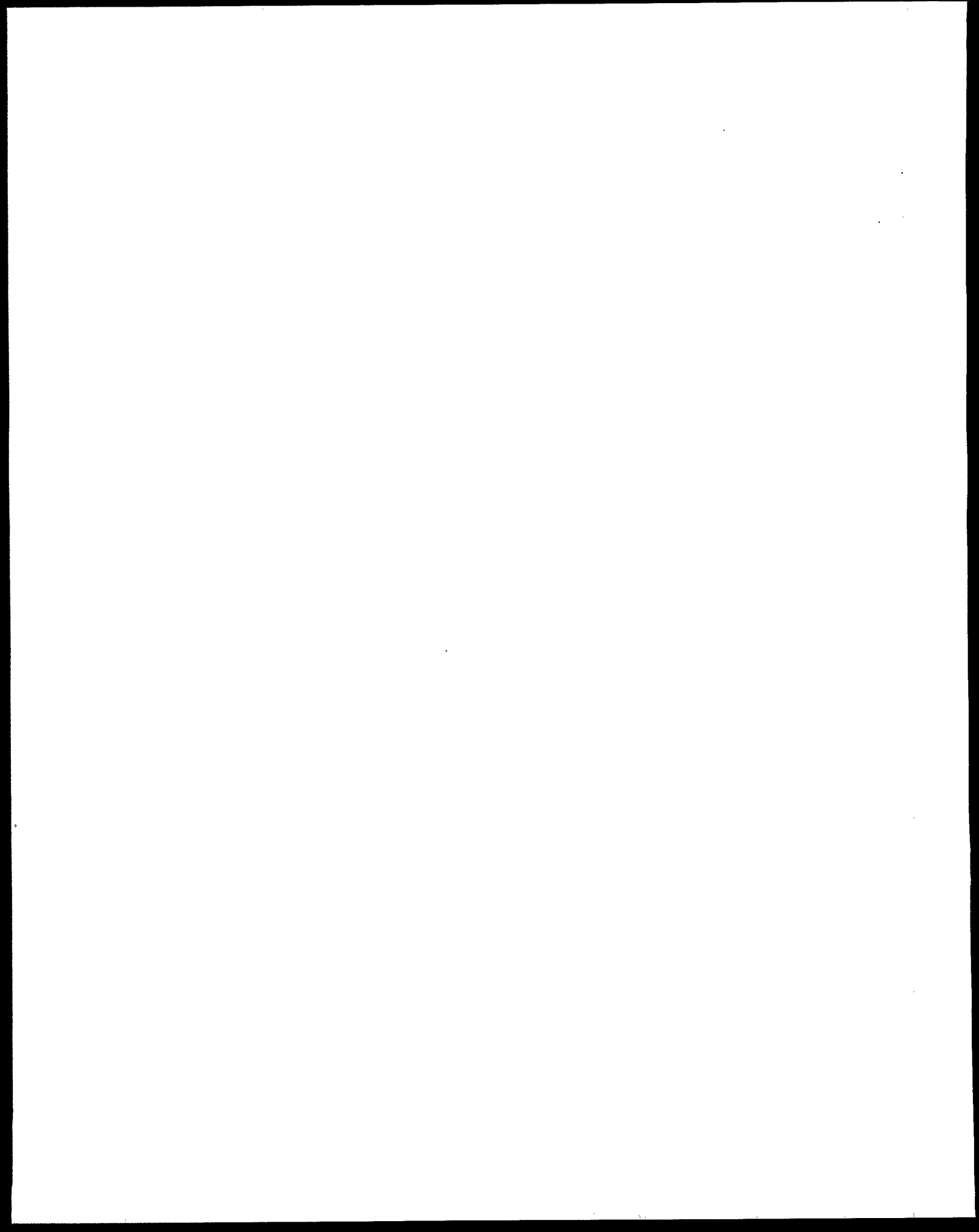
The purpose of this Directory is to provide information on government activities concerning ISO 14000 and/or Environmental Management Systems (EMS). It is therefore beyond the scope of the Directory to include a comprehensive listing of all the private sector organizations and initiatives also involved in ISO 14000 and/or EMS.

The ISO 14000 series of standards are copyrighted and can be obtained by contacting any of the following organizations: **ANSI**, 7315 Wisconsin Ave., Suite 250-E Bethesda, MD 20814. Tel: 301-469-3363. **ASTM**, 100 Bar Harbor Dr., West Conshohocken, PA 19428. Tel: 601-832-9721. Fax: 601-832-9666. **ASQC**, 611 East Wisconsin Ave., P.O. Box 3005, Milwaukee, WI 53201. Tel: 800-248-1946. Fax: 414-272-1734. **NSF International**, 2100 Commonwealth Blvd., Ann Arbor, MI 48105. Tel: 313-332-7333. Fax: 313-669-0196.

ACKNOWLEDGMENTS

This Directory was prepared under the direction and coordination of Emma Lou George of the U.S. EPA's Office of Research and Development, National Risk Management Research Laboratory in Cincinnati, Ohio, with assistance from Mary McKiel of the EPA Standards Network, Office of Pollution Prevention and Toxics, in Washington, DC.

Eastern Research Group, Inc. (ERG) of Lexington, Massachusetts, collected and compiled the information contained in the Directory, and prepared and edited the material for publication. Michael Cronin and Donald Fried-Tanzer, under the direction of Jeff Cantin, were the primary ERG contributors to its development.



INTRODUCTION

Overview

This Directory provides information about current initiatives related to the developing ISO 14000 series of environmental standards. Interest in the standards among governments, nongovernmental organizations, industry and the public is high and expected to grow as the standards become finalized. A measure of this interest is the fact that even before the first of the ISO 14000 series standards was issued, over 100 government and nonprofit organizations submitted information for inclusion in this Directory. This number excludes the hundreds of private sector initiatives, not included in this Directory, that are also underway. The U.S. Technical Advisory Group (TAG) to ISO Technical Committee 207 (the ISO Committee developing the ISO 14000 series standards), for example, consists of hundreds of members from industry, government, consulting firms, nongovernmental organizations, and academia (see Figure 2). Dozens of private sector organizations have emerged to offer training, consulting, and other services related to ISO 14000, while hundreds of individual companies are investigating ISO 14000 to determine its implications. At least two U.S. companies certified to ISO 14001 while the standard was still in draft form, and prior to the existence of U.S. nationally accredited registrars.

The reasons for this interest in the ISO 14000 series standards are not hard to find. It is a global series of standards developed outside regulatory channels that has the potential to revolutionize both the way industrial and other organizations manage environmental affairs, the way regulatory agencies relate to the regulated community, and the way customers and society at large relate to companies and other organizations. Whether this potential will be realized is not yet clear. Much will depend on how industry, governments, and nongovernmental organizations respond to, and use, the standards. If their potential is realized, the introduction of the ISO 14000 series standards could be one of the most significant environmental developments of our time.

This Directory is an effort by EPA to contribute to an understanding of the ISO 14000 series standards. It does not attempt to promote or discourage use of the standards. Rather, it is intended to facilitate communication among the many groups or individuals examining or using the standards. A useful first step in improving our understanding of the standards is to provide a forum where interested parties can communicate and learn from each others' experience.

What is ISO?

The International Organization for Standardization (ISO) is a private sector, international standards body based in Geneva, Switzerland. The short form "ISO" is not an acronym, but instead is derived from the Greek *isos*, meaning "equal" (implying "standard"). Founded in 1947, ISO promotes the international harmonization and development of manufacturing, product and communications standards. ISO has promulgated more than 8,000 internationally accepted standards covering everything from paper sizes to film speeds. More than 120 countries belong to ISO as full voting members, while several other countries serve as observer members. The United States is a full voting member and is officially represented by the American National Standards Institute (ANSI), a nongovernmental, nonprofit standards setting organization.

ISO produces internationally harmonized standards through a structure of Technical Committees (TCs). The TCs usually divide into Subcommittees (SC), which are further subdivided in Working Groups (WG) where the actual standards writing occurs. For example, ISO TC 207 is the ISO Committee developing the ISO 14000 series of standards, SC1 pertains to Environmental Management Systems (EMS), and SC1 WG1 produced the ISO 14001 standard (Figure 1 shows the structure of ISO TC 207).

International Organization for Standardization (ISO)

Geneva, Switzerland

Tel: 41-22-749-0111

Fax: 41-22-733-3430

<http://133.82.181.177/ikeda/ISO/home.html>

Technical Committee (TC) 207: Environmental Management

Secretariat: Canada

Chair: Dr. Margaret Kerr

Secretary: James L. Dixon

Tel: 416-747-4103

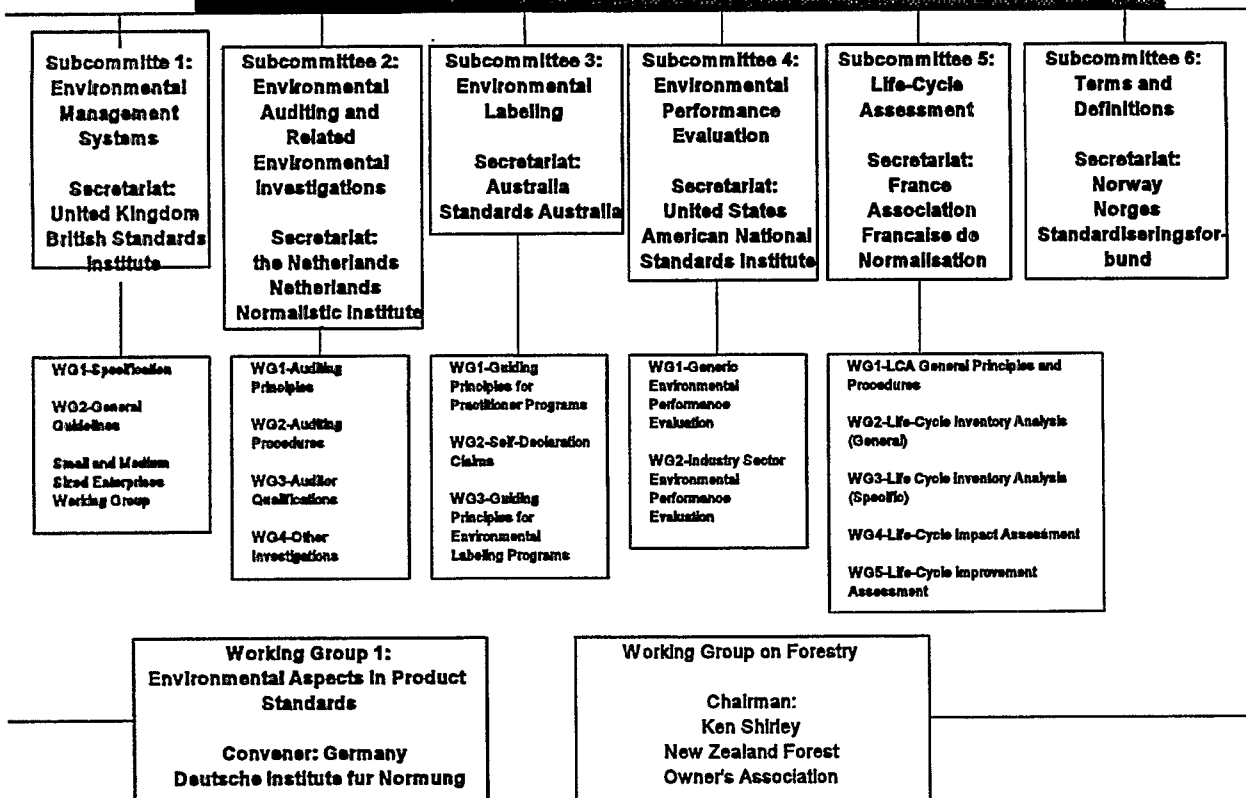


Figure 1. Structure of ISO Technical Committee 207.

Figure 2. U.S. Technical Advisory Group (TAG) to ISO TC-207

American National Standards Institute 212-642-4900	
US TAG to ISO/TC 207	
Chair: Joe Cascio 703 750 6401 jcascio@gnet.org	Vice-Chair: Mary McKiel 202-260-3584 mckiel.mary@epamail.epa.gov
ST1—Environmental Management Systems	
Chair: Joel Charm 201-455-4057 joel.charm@alliedsignal.com	EPA Rep: Jim Horne 202-260-5802 horne.james@epamail.epa.gov
ST2—Environmental Auditing	
Chair: Cornelius (Bud) Smith 203-778-6114 203-778-6487 Fax	EPA Rep: Cheryl Wasserman 202-260-8797 wasserman.cheryl@epamail.epa.gov
ST3—Environmental Labeling	
Chair: Jim Connaughton 202-736-8364 jconnaugh@sidley.com	EPA Rep: Julie Lynch 202-260-4000 lynch.julie@epamail.epa.gov
ST4—Environmental Performance Evaluation	
Chair: John Master 610-359-4810 610-359-4862 Fax	EPA Rep: John Harman 202-260-6395 harman.john@epamail.epa.gov
ST5—Life Cycle Assessment	
Chair: James Fava 610-701-3636 favaj@wcpst2.rfweston.com	EPA Rep: Mary Ann Curran 513-569-7837 curran.maryann@epamail.epa.gov
ST6—Terms and Definitions	
Chair: Christopher Bell 202-736-8118 cbell@sidley.com	EPA Rep: Mary McKiel 202-260-3584 mckiel.mary@epamail.epa.gov
SWG—Environmental Aspects in Product Standards	
Chair: Stanley Rhodes 510-832-1415	EPA Rep: John Shoaff 202-260-1831 shoaff.john@epamail.epa.gov

For information on joining the U.S. TAG, contact ASTM at 610-832-9721.

What are the ISO 14000 Series Standards?

The ISO 14000 standards are a series of voluntary standards developed under the ISO framework to address organizational environmental management. Like the ISO 9000 series quality standards on which they are largely modeled, the ISO 14000 series standards focus on management systems rather than on performance levels. Just as it is impossible to define "quality" across a wide range of products, it is difficult to define environmental performance across a wide range of activities, products, and services, as well as across differing national regulatory systems. The ISO 14000 series standards do not address the issue of performance. Instead, they identify management system elements that are intended to lead to improved performance: a method to identify significant environmental aspects; a policy that includes a commitment to regulatory compliance, the prevention of pollution and continual improvement; environmental objectives and targets for all relevant levels and functions in the organization; procedures to ensure performance, as well as compliance procedures to monitor and measure performance; and a systematic management review process. One of the issues regulatory agencies and stakeholders must consider is how these systems' conformance requirements will interact with regulatory performance requirements.

The ISO 14000 series of standards include "specification" standard, ISO 14001. The rest are guidance standards which provide optional guidance for companies developing and implementing management systems and product standards. The ISO 14001 specification standard "contains only those requirements that may be objectively audited for certification/registration purposes and/or self declaration purposes." The various standards are at different stages of development from published final International Standards (IS) to New Work Item (NWI) Proposals (see Figure 3).

ISO 14001, 14004, 14010, 14011/1 and 14012 are published final International Standards. For

the developing status of the other documents it is best to consult one of the many newsletters or Internet websites which track this information (please see Chapter 7, Resources).

The ISO 14000 series of standards are copyrighted and can be obtained by contacting any of the following organizations: **ANSI**, 7315 Wisconsin Ave., Suite 250-E, Bethesda, MD 20814, Tel: 301-469-3363. **ASTM**, 100 Bar Harbor Dr., West Conshohocken, PA, 19428, Tel: 610-832-9721, Fax: 610-832-9666. **ASQC**, 611 East Wisconsin Ave., P.O. Box 3005, Milwaukee, WI 53201, Tel: 800-248-1946, Fax: 414-272-1734. **NSF International**, 2100 Commonwealth Blvd., Ann Arbor, MI 48105, Tel: 313-332-7333, Fax: 313-669-0196.

Initiatives Described in this Resource Directory

Application and acceptance of the ISO 14000 standards are still evolving, therefore very few initiatives described in this Resource Directory are tightly tied to the ISO standards themselves. Organizations are not waiting, however, for all the various standards to be finalized. Instead, they are initiating a wide range of projects revolving around the major themes addressed in the ISO 14000 series standards: environmental management systems, product and process life cycles, extended producer responsibility, moving beyond compliance, environmental performance evaluation, third party certification, etc. For the purposes of this Resource Directory the definition of an "ISO 14000 Initiative" includes both projects related formally to the ISO 14000 series standards and those more loosely related to some of the major themes of the standards. With this scope identified, a wide variety of organizations were invited to submit information about initiatives that would be of interest to others tracking ISO 14000. The purpose of this Directory is to provide information on government activities concerning ISO 14000 and/or Environmental Management Systems (EMS). It is therefore beyond the scope of the Directory to include a comprehensive listing of all the private sector organizations and initiatives also involved in ISO 14000 and/or EMS. Each

entry includes a description of the initiative and provides the name, address and telephone number of a contact person who is prepared to discuss the results of their exploration with others examining or using the standards. Where possible, e-mail addresses and Universal Resource Locators, or URLs addresses (World Wide Web), have also been provided to facilitate electronic communication. This Resource Directory will also be available for download in *.pdf format online at: <http://www.epa.gov/ttnrmrl/ceri.htm> and in the near future will be interactive to allow users to access these resources directly through the Internet.

EPA's Involvement with ISO 14000

ISO 14000 is a voluntary, private sector initiative that EPA views has the potential to achieve environmental benefits. EPA has been involved in the development of the standards since their inception. EPA's Mary McKiel is the Vice Chairman of the U.S. Technical Advisory Group (TAG) to ISO Technical Committee 207. Moreover, EPA is represented on the Chairman's Advisory Group and on the U.S. National Accreditation Program for environmental management systems standards (ISO 14001). The chief mechanism for organizing EPA's involvement with ISO 14000 is the Voluntary Standards Network.

The Voluntary Standards Network was established by Administrator Carol Browner in 1993 to address international voluntary standards activities. A primary focus of the Network has been to coordinate the Agency's participation in the development of the ISO 14000 standards for environmental management. This coordination helps ensure that the Agency speaks with one voice on important issues and activities as they pertain to voluntary standards, such as the ISO 14000 series.

Key EPA activities to date have included:

- **Providing an information clearinghouse.** EPA activities such as this Directory are intended to inform the regulatory community, stakeholder groups, and other interested parties (including industry) of key activities taking place both within the ISO setting, and among government agencies and nonprofit organizations.
- **Evaluating the potential usefulness of ISO 14000 in a regulatory setting.** A number of projects are underway to evaluate whether and how the ISO 14000 series standards interact with regulatory requirements. Numerous legal and practical issues remain to be resolved in evaluating ISO 14000 as a complement to regulatory programs. These issues are being addressed in pilot projects that will provide useful lessons for future programs.
- **Assisting small and mid-sized companies.** A key issue facing small and mid-sized companies will be how to adapt to the requirements of ISO 14000 with fewer resources than those available to the large multinational companies that participated heavily in the development of standards.
- **Organizing conferences.** EPA Headquarters held a one-day conference on ISO 14000 in February, 1997 in Washington, DC. The conference provided an overview of the ISO 14000 standards, and included presentations from EPA offices involved in standards development and pilot projects.

Other Initiatives Related to ISO 14000

- As illustrated in this Resource Directory, other government agencies, state governments, and nonprofit organizations are involved in a number of significant initiatives related to ISO 14000. Included are:

- Work groups and study groups established by federal agencies, states, and multilateral organizations to evaluate the potential role of ISO 14000 in regulatory and nonregulatory programs.
- Initiatives by various departments of the federal government and the U.S. Postal Service to use ISO 14000 in facilities management.
- Inclusion of ISO 9000 and ISO 14000 by the Food and Drug Administration in environmental management system registration.
- Development of tools for ISO 14000 by the National Institute of Science and Technology (NIST) Manufacturing Extension Programs (MEP) which provide technical assistance to small and medium sized enterprises (SMEs).
- Programs in over 28 states to include, or to consider ISO 14001, as part of innovative environmental management programs.
- Industry and trade association programs to acquaint their members with ISO 14000.

How To Use This Resource Directory

This Resource Directory is intended principally as a forum for users and interested parties to learn about ISO 14000, to find out who is involved in ISO 14000-related initiatives, and to communicate with one another. The Directory contains information primarily on initiatives being developed by government and nonprofit organizations. Other organizations are developing useful directories of resources and initiatives in the for-profit sector (see Chapter 7, Resources). It is important to recognize, therefore, that in addition to the resources listed in this Directory, there exist numerous other directories, newsletters, and other publications related to ISO 14000, as well as a wide range of private organizations that organize conferences,

provide training programs, and assist with implementation of ISO 14000.

EPA hopes that the audience for this Resource Directory will be able to use it in a number of ways:

- Review the Directory from beginning to end to get an idea of the breadth and scope of initiatives currently underway.
- Reference the sections that include organizations you work with to see what initiatives are underway and learn how they may affect you.
- Find out about initiatives underway in your local area by referencing the state-by-state or regional EPA listings.
- Look up organizations similar to yours to find out what they are doing and learn from their progress to date.

Reference the online version of this directory at EPA's Technology Transfer webpage: <http://www.epa.gov/ttnrmrl/ceri.htm> (to be in place in early 1998) and use the search engine to find entries by keyword.

Acronyms and Abbreviations Used in this Resource Directory

EMS	Environmental Management Systems
E-mail	Electronic Mail
ISO	International Organization for Standardization
P2	Pollution Prevention
SME	Small to Medium Sized Enterprises

Figure 3. Standards in the ISO 14000 Series—Status as of June 1997

<i>Organizational Evaluation</i>		
ISO 14001	Environmental Management Systems—Specifications with Guidance for Use	Final International Standard
ISO 14004	Environmental Management Systems—General Guidelines on Principles, Systems, and Supporting Techniques	Final International Standard
ISO 14010	Guidelines for Environmental Auditing—General Principles on Environmental Auditing	Final International Standard
ISO 14011/1	Guidelines for Environmental Auditing—Audit Procedures—Audit of Environmental Management Systems	Final International Standard
ISO 14012	Guidelines for Environmental Auditing—Qualification Criteria for Environmental Auditors	Final International Standard
ISO 14015	Environmental Site Assessments	First Working Draft
ISO 14031	Evaluation of Environmental Performance	Committee Draft
<i>Product Evaluation</i>		
ISO 14040	Environmental Management—Life Cycle Analysis—Principles and Framework	Under vote as Final International Standard
ISO 14041	Environmental Management—Life Cycle Analysis—Life Cycle Inventory Analysis	Committee Draft for ballot
ISO 14042	Environmental Management—Life Cycle Analysis—Impact Assessment	Working Draft
ISO 14043	Environmental Management—Life Cycle Analysis—Interpretation	Working Draft
ISO 14020	Goals and Principles of All Environmental Labeling	Committee Draft for Comment
ISO 14021	Environmental Labels and Declarations—Self Declaration Environmental Claims—Terms and Definitions	Draft International Standard
ISO 14022	Environmental Labels and Declarations—Self Declaration Environmental Claims—Symbols	Under vote as Committee Draft
ISO 14023	Environmental Labels and Declarations—Self Declaration Environmental Claims—Testing and Verification	as above
ISO 14024	Environmental Labels and Declarations—Environmental Labeling Type I—Guiding Principles and Procedures	Committee Draft
ISO 14025	Environmental Labels and Declarations—Environmental Information Profiles—Type III Guiding Principles and Procedures	New Work Item
ISO Guide 64	Guide for Inclusion of Environmental Aspects in Product Standards	ISO Guide
<i>Overall</i>		

Figure 3. Standards in the ISO 14000 Series—Status as of June 1997

ISO 14050	Terms and Definitions—Guide on the Principles for ISO/TC 207/SC6 Terminology Work	Draft International Standard
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ISO Standards Development Process:

(1) New Work Item proposal, (2) New Work Item assigned to Subcommittee, (3) Working Draft, (4) Committee Draft, (5) Draft International Standard (or optional Final Draft International Standard), (6) International Standard.

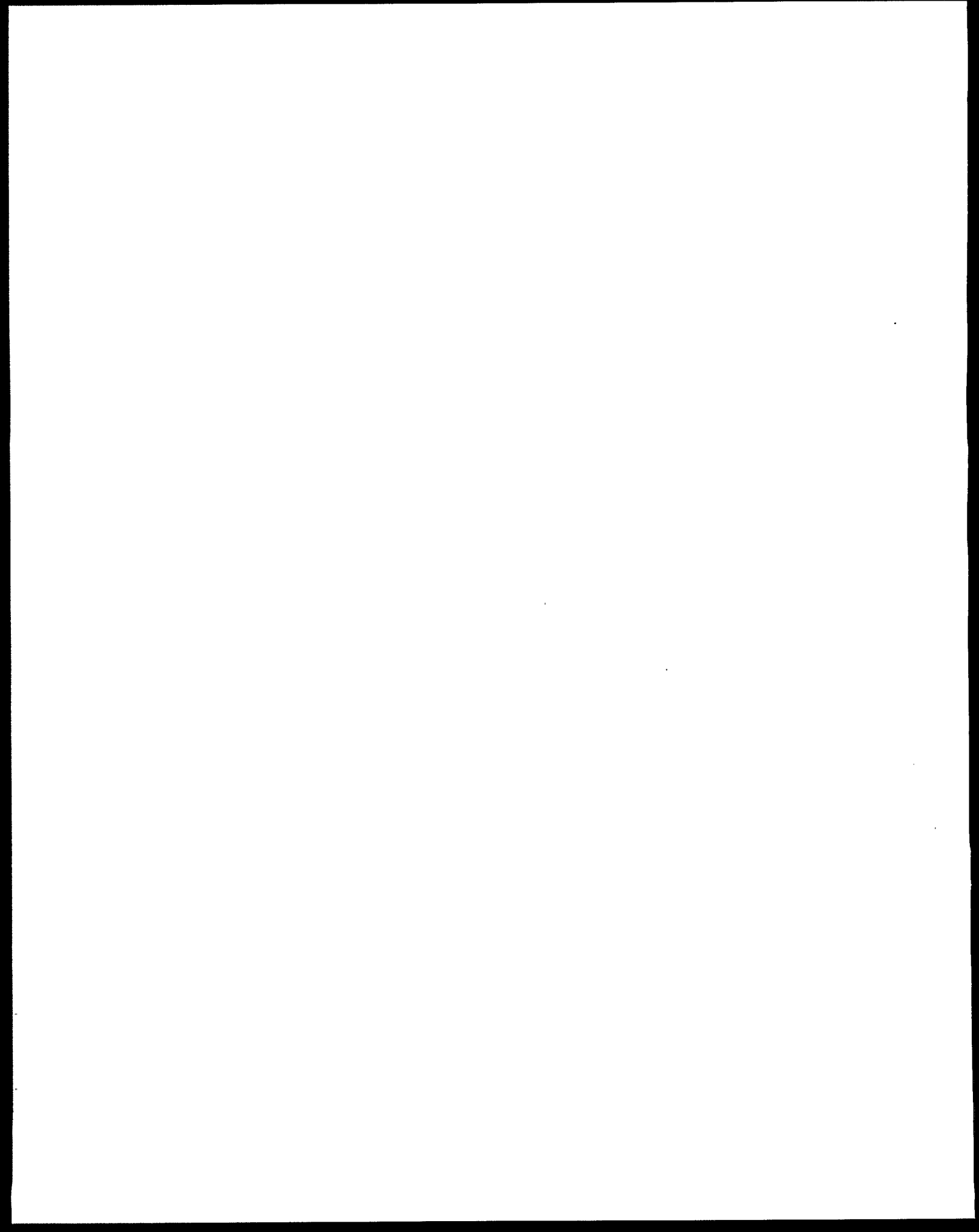
How To Update This Resource Directory

Like the ISO 14000 standard development process, this Resource Directory is a work in progress. Over the coming months and years, it will evolve dramatically as new initiatives are added and other initiatives are completed or discontinued. This Resource Directory will only function well if it is maintained in an up-to-date manner. For that the Agency must rely on the user community. We therefore ask you, the users of the Resource Directory, to help us keep it up to date by informing us of:

— New entries to add to the Directory.

- Corrections to entries listed in the Directory.
- Updates and changes in your activities.
- New initiatives undertaken by your organization.
- Leads on new or existing initiatives that have not been included in this Resource Directory.

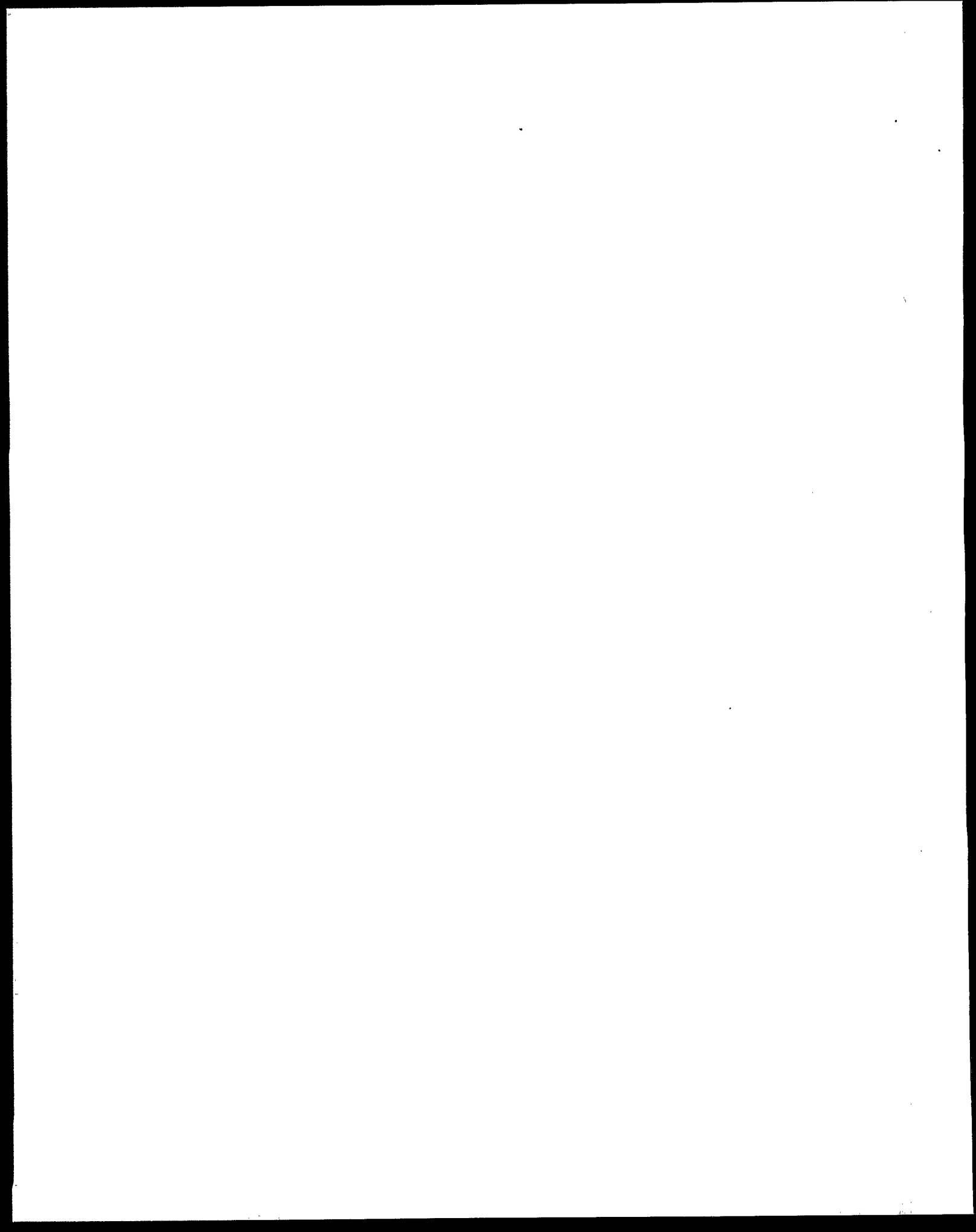
Please use the form on the inside back cover of the Resource Directory to submit updates, corrections, and information on new initiatives.



U.S. EPA INITIATIVES

Numerous offices within the United States Environmental Protection Agency (EPA) are examining the ISO 14000 series of standards and considering its effects upon their program and activities. The first part of this chapter lists initiatives undertaken by EPA headquarters offices, sorted alphabetically by the lead EPA office. The second part lists regional EPA initiatives, presented in numerical order by EPA region.

- 1. Agency-wide Initiatives**
- 2. Headquarters Initiatives**
- 3. Regional Initiatives and Support**



AGENCY-WIDE INITIATIVES

The Voluntary Standards Network

The Voluntary Standards Network was established by EPA Administrator Browner in 1993 to address international voluntary standards activities. A primary focus of the Network has been to coordinate the Agency's participation in the development of the ISO 14000 standards for environmental management. With the passage of the National Technology Transfer and Advancement Act in 1996, the Network also acts a principal means by which the EPA Standards Executive communicates policies and procedures regarding national and international voluntary consensus standards to the designated Agency Standards Coordinators. The Standards Coordinators are key points of contact for the Network. The Network mechanism assists the Agency in developing positions on the development and implementation of standards, including the ISO 14000 standards, and identifying their applicability to EPA projects and initiatives. The Network also provides standards-related information and training to EPA offices nationwide and works closely with the EPA Trade and Environment Task Force on issues involving international trade agreements such as the World Trade Organization. Coordination through the Network helps ensure that EPA speaks with one voice on important activities as they pertain to standards, such as the ISO 14000 series. To date, there are over 160 members of the Network from across the Agency. While the Network is administered by the Office of Pollution Prevention and Toxics, other Agency Offices and Regions are actively involved and take lead roles in the Network activities.

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HEADQUARTERS INITIATIVES

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Office of Air and Radiation (OAR)

Natural Gas STAR Program. This voluntary program is designed to cost-effectively reduce emissions of greenhouse gases from the natural gas industry. Developed as a partnership between the EPA and the natural gas industry, the program addresses emissions of methane and

carbon dioxide through a series of cost-effective best management practices.

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OAR Web site. The OAR Web site is the clearinghouse for information on EPA's efforts to protect and preserve air quality.

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Office of Enforcement and Compliance Assurance (OECA)

Environmental Leadership Program (ELP). ELP is one of the 25 Reinventing Environmental Regulations announced on March 16, 1995, by President Clinton. A 1-year pilot phase was completed in August 1996 that evaluated opportunities for new tools using third party auditing and alternative performance-based management systems. The success of the 12 pilot projects demonstrated the effectiveness of partnerships with state environmental agencies, and the cooperative ability in conducting a voluntary program with industry and federal facilities.

The goals for the implementation of the full-scale ELP by January 1997 include 1) better environmental and human health protection by promoting a systematic approach to managing environmental issues and by encouraging environmental enhancement activities; 2) increased identification and timely resolution of environmental compliance issues by ELP participants; 3) multiplying the compliance

assistance efforts by including industry as mentors; and 4) fostering constructive and open relationships between agencies, the regulated community, and the public.

The foundation for recognizing environmental leaders will be the implementation of an environmental management system (EMS), an integrated, structured, and systematic approach for identifying significant environmental impacts resulting from an organization's activities, products, and services. The intent is to achieve compliance with environmental regulations, provide an ability for continuous improvement, identify opportunities for implementing pollution prevention activities and practices, and communicate effectively with outside stakeholders on the organization's EMS and its performance.

The 6-year ELP participation period is designed to publicly recognize specific facilities or entities, as well as offer benefits for participation through reduced inspections, a self-correction period for violations, and streamlined administrative requirements. EPA anticipates that the ELP will be coordinated in partnership with interested state environmental agencies, in order to extend the benefits offered on a state-by-state basis. Facilities/entities will be required to conduct compliance and EMS auditing in conjunction with third party verification of the audits. EPA will also make an annual environmental report available to the public. This proposed framework is currently available to all stakeholders for review and comment.

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ISO 14001/EMS Task Group. This task group is composed of representatives from all major EPA offices and 8 Regions, the Department of Justice, and 18 states (Alaska, Arizona, California, Colorado, Delaware, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Washington, and Wisconsin).

The primary purpose of the task group is to determine and make recommendations regarding the relationship between ISO 14001, EMS standards, compliance, enforcement, and improved environmental performance. By fall 1997, EPA expects to solicit public comment on metrics or indicators for evaluating environmental performance in EMS pilots.

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Office of Federal Activities

EMS Audit Procedural Guidelines. A sub-task group of the U.S. Technical Advisory Group (U.S. TAG) for ISO's EMS development produced the EMS audit procedural guidelines. A final draft currently out for comment will be used in conjunction with ISO Standard Guidelines in Environmental Auditing Principles, procedures and qualifications set forth in ISO14010-12 related to environmental auditing. These guidelines will assist auditors conducting ISO 14001 conformance audits and set boundaries for EMS audits used for internal self-assessments, self-certifications of conformity with ISO 14001, or by registrars for ISO 14001 registrations to ensure they are at once credible, replicable, and not overly burdensome or interpretive of the ISO standards. This document will be revised as needed upon

further review within the United States and among key stakeholder groups.

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Office of Policy, Planning, and Evaluation (OPPE)

Indiana Small Business Pilot Project. Please see Chapter 4, under Indiana, for full listing.

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Office of Prevention, Pesticides and Toxics

Consumer Labeling Initiative. The Consumer Labeling Initiative's goal is to foster pollution prevention, empower consumer choice, and improve understanding by presenting clear, consistent, and useful safe use, environmental, and health information on household consumer product labels. This is a multi-phased voluntary pilot project focusing on indoor insecticides, outdoor pesticides, and household hard surface cleaners.

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Environmental Accounting Project. The Environmental Accounting Project is a nonregulatory partnership program with a mission of helping organizations highlight the economic benefits of practicing pollution prevention. Its objective is to encourage and motivate businesses to understand the full spectrum of their environmental costs, and integrate these costs into strategic decision-making.

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Environmentally-Preferable Public Purchasing. The Environmentally Preferable Purchasing Program implements Executive Order 12873 which requires EPA to "issue guidance that recommends principals that Executive agencies should use in making determinations for the preference and purchase of environmentally preferable products" and services. The Program's goal is make environmental performance a factor in Federal government purchasing decisions, along with traditional factors, such as product performance and cost.

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Expanding the Use of Environmental Information by the Banking Industry Through ISO 14000. This effort will initially be an EPA-funded study to explore the potential utility of ISO 14000-generated information for banks in their risk management practices.

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Office of Research and Development (ORD)

Environmental Technology Verification Program. EPA has evaluated technology to determine their effectiveness in preventing, controlling, and cleaning up pollution. As a part of the Environmental Technology Initiative, EPA is now expanding these efforts by instituting a new program, the Environmental Technology Verification Program (ETV), to verify the performance of a larger universe of innovative technical solutions to problems that threaten human health or the environment. ETV was created to substantially accelerate the entrance of new environmental technologies into the domestic and international marketplace. It supplies technology buyers and developers, consulting engineers, states, and EPA regions

with data on the performance of new technologies to encourage more rapid protection of the environment with better and less expensive approaches. EPA will utilize the expertise of both public and private partner "verification organizations," including federal laboratories, states, universities, and private sector facilities, to design efficient processes for conducting or overseeing performance tests of innovative technologies.

Verification organizations will oversee and report verification activities based on testing and quality assurance protocols developed with input from all major stakeholder and customer groups associated with the technology area.

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Implementing EMS in the Metal Finishing Industry. In this EPA-funded project, 11 organizations from the metal finishing industry are piloting the implementation of the ISO 14001 Standard. The project will result in a publicly available report, in addition to an EMS guidance document for metal finishers. The metal finishing report and guidance document will be completed by December 1997.

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Office of Water (OW)

EMS Demonstration Project. This EPA project has provided seed money for 18 public and private organizations to put an EMS in place using ISO 14001 as a model. The program has provided initial training and follow-up consulting through NSF International. This initiative will generate a series of reports on the various pilot projects, which will be available through the OW resource center in both hard copy and on the Internet.

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EMS Implementation Guide for Small- and Medium-Sized Organizations. EPA's Office of Water and Office of Compliance, in conjunction with NSF International, has developed an implementation guide geared specifically to the needs of small- and medium- sized organizations. The elements of the document are based on the ISO 14001 Standard. The guide is formatted and written in such a way as to give these types of organizations useful ideas on how to begin implementing EMS and ways to find additional helpful information.

Using EMS To Meet Watershed Protection Goals. This project seeks to contribute to the attainment of watershed goals through a system-based voluntary approach. Participants are linked to achievement of watershed goals in the Arbor- Middle Kron River Watershed. A joint

project of OW and the county government in Washtenaw County (Michigan), the initiative involves recruiting organizations to participate in training and improving technical systems relevant to the organization.

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EMS Implementation by Municipal Governments. OW hopes to work with selected municipal or county government organizations that are willing to implement EMS for their various activities, using ISO 14001 as a baseline. Preliminary discussions with interested parties have begun and an overall project implementation plan is expected in Fall 1997. This effort will demonstrate the relevance of EMS for public-sector organizations.

OW EMS Implementation Workgroup. OW, in conjunction with regional offices and states, is forming a workgroup to explore possible ways to encourage implementation of EMS by facilities regulated under various parts of the water program. The workgroup will concentrate on issues relating to regulatory programs in areas such as permitting, and explore the possible use of incentives for facilities with good compliance records that can also implement effective EMS. ISO 14001 will serve as the baseline for this effort, but the workgroup will also examine other possible criteria that facilities may need to satisfy as a condition for any type of regulatory or other flexibility.

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Office of Federal Facilities Enforcement

Code of Environmental Management

Principles for Federal Agencies (CEMP).

CEMP, an element of the Federal Government Environmental Challenge Program established in response to Section 4-405 of Executive Order 12856, is a set of five principles encouraging federal agencies to be more aware and visionary in their management of environmental protection issues. The principles incorporate many common elements of EMS, and ISO 14001 and several other public and private sector documents were used as background. A Pacific Northwest National Laboratory (PNNL) team supported EPA's Office of Federal Facilities Enforcement in developing the CEMP. EPA has asked federal agencies to endorse the principles and provide a description of how they will be implemented at the facility level.

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EMS Primer for Federal Facilities. EPA's Federal Facility Enforcement and DOE's Office of Environmental Policy and Assistance are jointly sponsoring the development of an Environmental Management Systems Primer for Federal Facilities with EPA's Office of Federal Facilities Enforcement. A PNNL team is supporting development. Topics covered will include an introduction to EMS and federal facility issues; the first steps in building an EMS; regulatory issues; innovative regulatory

approaches; performance indicators; pollution prevention; audits and conformity assessment options; and the National Environmental Policy Act (NEPA). The primer is designed to be concise, include extensive references, and provide useful examples and concrete steps.

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(This entry is cross-listed under DOE initiatives in Chapter 3.)

National Enforcement Investigations Center

Compliance-Focused EMS. Since the late 1980s, civil multimedia compliance investigations conducted by the NEIC have increasingly involved identifying causes of observed noncompliance. When investigated, noncompliance most often appeared to be caused by dysfunctional EMS. Through this work and by participating in followup enforcement actions, NEIC developed criteria for a compliance-focused EMS that has been used as the basis for several of the settlement agreements when EMS improvements were required. The agreements required the organization to document policies, systems, procedures, and standards for 11 program elements, with the resulting document serving as a guidebook to

more detailed procedures and processes located elsewhere at a facility.

The intended result is to develop an EMS that will both improve the organization's compliance with applicable environmental requirements and lead to improved environmental performance. The elements were synthesized primarily from EMS assessment protocols developed for the Global Environmental Management Initiative (1992) and a regulated industry (1994) by Deloitte and Touche LLP of San Francisco; ISO 14001; National Sanitation Foundation EMS standards (NSF 110-1995); and the due diligence definition in the EPA policy regarding Incentives for Self-Policing (60 FR 66710). Element refinement continues through settlement negotiations and discussions with EPA staff, EMS consultants, and environmental personnel from several companies with medium and large facilities.

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Project XL

XL projects are real world tests of innovative strategies that achieve cleaner and cheaper results than conventional regulatory approaches. EPA will grant regulated entities regulatory flexibility in exchange for their commitment to achieve better environmental results than would have been attained through full regulatory compliance.

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EPA REGIONAL INITIATIVES AND SUPPORT

Region 1

StarTrack. EPA's regional office in Boston is conducting a groundbreaking experiment to privatize compliance assurance for leading companies. Built on the ISO 14000 model, the region will be empowering third parties to certify to three basic components: 1) an environmental management system modeled on ISO 14001; 2) facility environmental compliance and pollution prevention audits; and 3) a commitment to correct certain violations within an established time frame. The third party will certify to each component and provide a summary report. In return, EPA will grant certified companies limited penalty amnesty, no routine inspections, simplified reporting and expedited permitting. EPA plans to refocus resources previously devoted to these sources to issues that pose a greater risk to the environment.

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Environmental Leadership Program-New England. EPA's regional office in Boston is conducting a regional environmental leadership program to encourage and reward environmental leadership and to experiment with alternative models to achieve environmental compliance.

The region periodically requests applications for businesses or other organizations that have demonstrated a commitment to environmental performance going beyond regulatory compliance. Selected organizations receive public recognition, and partner with the region to experiment with alternative approaches. In many cases, companies are experimenting with approaches based on the ISO EMS, including self-certification and mentoring EMS implementation with customers and suppliers.

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Tel: 617-860-4ELP or
Gina Snyder at 617-565 -9452
Fax: 617-565-4939
E-mail: snyder.gina@epamail.epa.gov
URL: <http://es.inel.gov/elp>

Compliance Leadership Through Environmental Audits and Negotiation (CLEAN). EPA's regional office in Boston has launched an effort to improve environmental management and performance in smaller companies. In exchange for a commitment to achieve performance, in part by adopting pollution prevention practices, SMEs receive a comprehensive compliance and pollution prevention assessment by a partnership comprising federal, state, and private sector experts. The program is determining how these assessments may include an analysis of EMS based on 14000 to help these small companies maintain compliance.

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Region 3

ISO 14000 Project XL. The projects combine the ISO 14000 standards with the requirements of the Project XL initiative, thereby adding greater environmental specificity to the usage of ISO 14000 standards in the United States. As the EMS is developed, EPA will focus on defining superior environmental results, establishing public involvement, developing methods of pollution prevention, and improving processes and results.

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Philadelphia, PA 19107
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Addr: Deborah Sabatini Hennelly
Lucent Technology
131 Morristown Road
Basking Ridge, NJ 07920
Tel: 908-630-2814
Fax: 908-204-8865

Region 4

Using ISO 14000 in the Paper Industry. The Weyerhaeuser Flint River Operations paper mill has signed a Project XL Agreement with EPA. The Weyerhaeuser paper mill will implement ISO 14000 at its Flint River site in Georgia. The overall objective of this XL Agreement will be to half the solid waste at the facility, cut energy consumption, reduce the toxic waste stream, and set records for low water usage for a paper mill of its size.

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Addr: William (Bill) Patton (Project XL)
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Atlanta, GA 30303

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Region 5

Life Cycle Assessment Methodology. This effort is developing and demonstrating Life Cycle Assessment (LCA) applications within industry and government. Specifically, the focus has been on streamlined LCA applications. Existing LCA data is being analyzed using methods currently employed by LCA practitioners. Areas of demonstration include alternative adhesives for auto interiors, recycled versus virgin newsprint for newspapers, alternative cleaning systems, fiberglass reinforced plastics, and composite wood. The estimated completion date is September 1997.

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Region 6

ISO 14000: A National Dialogue. This national conference was one in a series of events designed to facilitate a dialogue on issues surrounding ISO 14000 and its implementation. EPA Region 6 presented this conference in conjunction with the Global Environment & Technology Foundation (GETF) and the University of Texas at Arlington (UTA) on November 11-12, 1996, at the UTA campus.

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EPA Region 6
Tel: 214-665-6487
Fax: 214-665-2168

Addr: Richard Cooper

GETF
Tel: 703-750-6401
Fax: 703-750-6506

Addr: Dr. Gerald Nehman
UTA
Tel: 817-272-2300

Region 8

EMS for Federal Facilities. EPA Region 8 conducted EMS reviews at selected federal facilities in February 1997. In conjunction with this activity, an EPA consultant offered training in the ISO 14001 Standard.

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Pollution Prevention Office (8P2-P2)
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Fax: 303-312-6741
E-mail: thiel.diane@epamail.epa.gov

Region 9

The Merit Partnership for Pollution Prevention. The Merit Partnership for Pollution Prevention is a "public-private partnership" dedicated to the advancement of pollution prevention technologies and practices that both protect the environment and aid economic growth.

Merit is developing a series of pilot projects to demonstrate the environmental and economic impacts of ISO 14001. The Merit ISO projects will explore a number of issues, including the effect of ISO 14001 on a company's environmental insurance options, how ISO 14001 may affect companies' government procurement opportunities, the accounting costs of the development and implementation of ISO 14001, and the effect of ISO 14001 on companies' environmental compliance records.

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Region 10

Evaluation of Policy Implications of ISO 14000 and Other EMS Standards. The overall objective of this effort will be to examine how ISO 14000 and other EMS standards can help make regulatory activities more effective (reducing pollution) and efficient (reducing the costs of assistance, compliance, and enforcement). This assessment will include a review of existing pilot projects and initiatives on a regional and national level, a review of the professional literature related to standards deployment, and an analysis of what this information implies for policy making and regulatory reform efforts currently underway within the region.

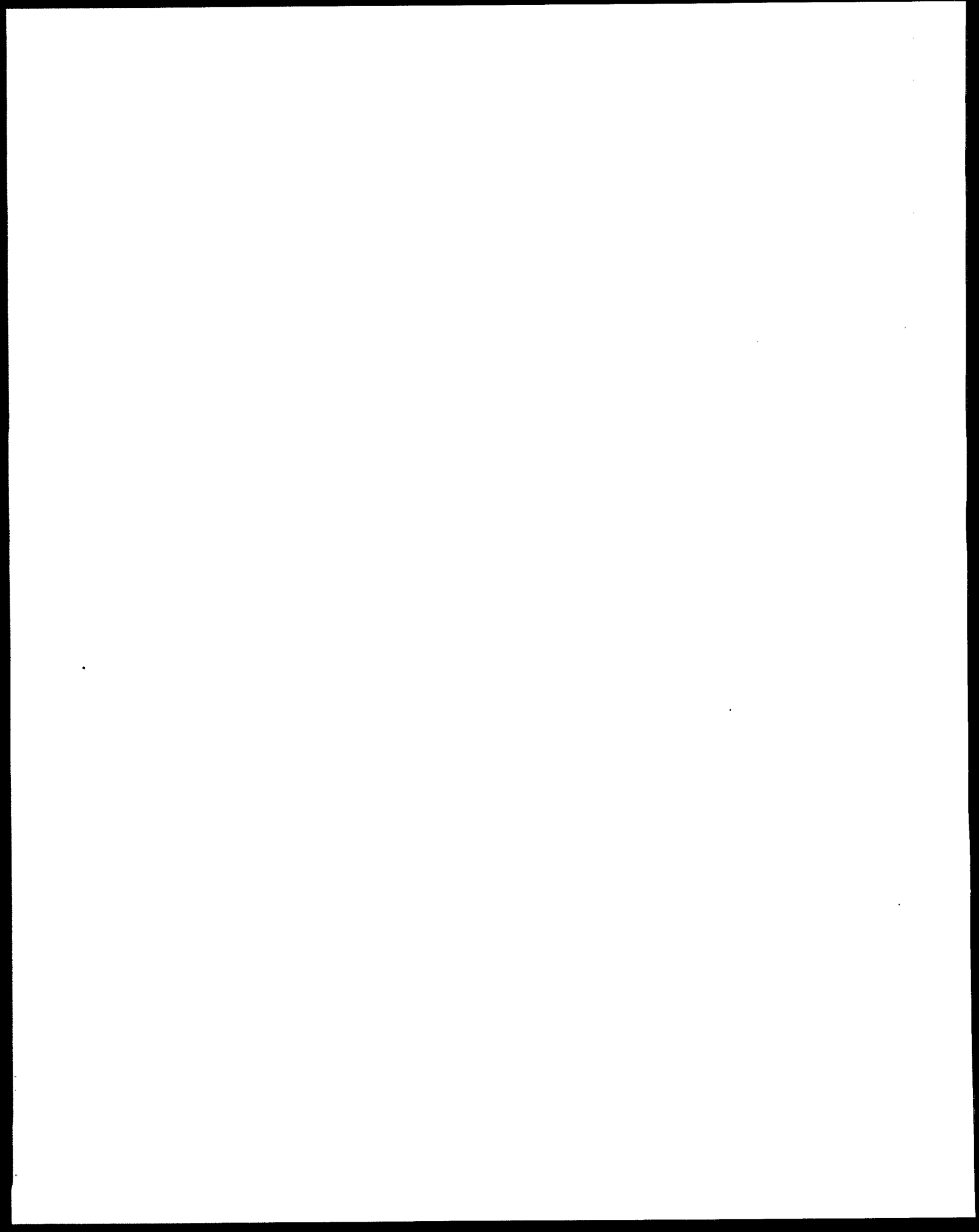
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Addr: Scott Butner, Senior Research Scientist
Environment and Society Group
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E-mail: butner@battelle.org
URL: <http://www.seattle.battelle.org>

3 OTHER FEDERAL INITIATIVES

Many federal agencies besides EPA are also interested in the ISO 14000 series of standards. These range from the Department of Commerce, which has an interest in how the standards may affect trade and competitiveness, to the U.S. Army, which is considering using IO 14001 management systems principles to manage their facilities. This chapter includes initiatives funded and managed by federal government departments and agencies other than EPA. The listed initiatives explore the use of ISO 14000 in their respective jurisdictions and also application of ISO 14000 within the departments or agencies themselves.

- 1. Department of Commerce**
- 2. Department of Defense**
- 3. Department of Energy**
- 4. Department of State**
- 5. Food and Drug Administration**
- 6. Federal Trade Commission**
- 7. U.S. Postal Service**



DEPARTMENT OF COMMERCE

National Institute of Standards and Technology (NIST)

Informational Paper. The NIST has published an informational paper on the evolving ISO 14000 series.

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National Institute of Standards and
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Gaithersburg, MD 20899
Tel: 301-975-2396
Fax: 301-963-2871
E-mail: mary.saunders@nist.gov
URL: [http://ts.nist.gov/ts/htdocs/
210/216/envIRON.html](http://ts.nist.gov/ts/htdocs/210/216/envIRON.html)

Interagency Committee on Standards Policy's EMS/ISO 14000 Workgroup. The operating guide for the workgroup is to provide information and recommendations to the Interagency Committee on Standards Policy regarding development and implementation of the ISO 14000. The committee has chosen to focus its initial efforts on four main areas: 1) implementation and integration with other systems and federal role in pilots; 2) metrics and evaluation of proposed indicators, cost measurement, and relationship to current indicators; 3) technical assistance and the role of federal government in providing technical assistance to NGOs, SMEs, other state and federal government bodies; 4) procurement and ISO 14000 fit with policies, contracting issues, and federal acquisition regulations. The workgroup is co-chaired by Ms. Mary McKiel of EPA and Mr. Larry Stirling of DOE.

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Environmental Projects Manager
Office of Standard Services &
Manufacturing Extension Partnership
NIST

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Manufacturing Extension Partnership (MEP)

Formerly the Manufacturing Technology Center program, this partnership is a nationwide system of manufacturing extension centers, state planning nonprofit support, and coordinated information, services, and resources. The partnership is designed to bridge a technological gap between sources of manufacturing technology and the small- and medium-sized enterprises (SMEs) that need to improve their competitiveness through the use of appropriate modern technologies, processes, and techniques.

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ISO 14000 Workgroup for the National P2 Roundtable. Please see Chapter 4, under North Carolina, and Chapter 5, under Nongovernmental Organizations, for full listing.

ISO 14000/EMS Gap Analysis Tool Suite. The tool suite will include an implementation primer that will detail protocol for implementation of an EMS gap analysis with three appendices. A case study of an EMS gap analysis used as a screening tool by field engineers and consultants for marketing, to present the benefits of ISO 14000 and EMS will be included. One initial output from the screening tool will be a 1-2 page letter with a visual attachment showing gaps in conformance to ISO 14001. This gap analysis will cover the main elements of the standard and may lead to a detailed EMS gap analysis or an implementation project. Also, the appendices will illustrate the EMS gap analysis as a detailed

ISO 14001 audit, and include an interpretation guide (glossary of terms).

The tool will use a "look for ... and look at..." type of format with a rating system for the field engineer or consultant to rank the company on a per-element basis. This project is being created by a consortium of MEP centers, private firms, and NIST-MEP.

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Greenscore™. Greenscore™ is an environmental self-assessment tool.

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NCMS
3025 Boardwalk Drive
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Environmentally Conscious Manufacturing (ECM). Please see Chapter 4, under Maine, for full listing.

ISO 14000 Awareness for Maryland Manufacturers. Please see Chapter 4, under Maryland, for full listing.

Vermont Manufacturing Extension Center. Please see Chapter 4, under Vermont, for full listing.

DEPARTMENT OF DEFENSE (DOD)

Environmental Management Systems Committee

The Office of the Deputy Undersecretary of Defense for Environmental Security has established an Environmental Management Systems Committee to examine the feasibility of implementing EMS, such as the ISO 14000 series. In addition to work within the Department, DOD is working with North American Trade Organization (NATO) and Partnership for Peace nations (Eastern European nations, the newly independent Baltic/Slavic states, Finland, and Sweden) to determine how environmental management systems can be implemented in the military. The purpose of DOD analysis of environmental management systems is to determine whether adoption of environmental management standards will improve the quality of DOD's environmental programs through the application of uniform quality management techniques.

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U.S. Army

Adoption of ISO 14000 Methodologies for Environmental LCA being conducted on weapon systems and materials. The Systems Life Cycle Readiness Office, Armament Research and Development Command, acts as a bridge between the developer and the producer of new materials and systems. Key aspects include life cycle evaluations of producibility and environmental impacts, costs, and risks. This office conducts environmental LCAs

(research and development, production, fielding and storage, and disposal) of new components or systems. It also works closely with operating sites on environmental management plans and initiatives on pollution prevention and compliance. This parallels industry's life cycle stages and activities as addressed by EPA, Society of Environmental Toxicology and Chemistry (SETAC), and ISO 14000.

Recent DOD guidance on Acquisition Strategy has strengthened many areas of LCAs that are parallel with emerging SETAC and ISO guidance.

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URL: <http://www.pica.army.mil/orgs/slcro/top.html>

Total Quality Environmental Management (TQEM) - Green Initiatives. This program is a U.S. Army Armament Research, Development, & Engineering Center (ARDEC) program that provides linkage between current quality initiatives and programs in environmental stewardship. The pilot programs will be implemented by industry and government partners who will voluntarily adopt the ISO 14000 environmental management system standards. By achieving ISO 9000/14000 certification, Army contractors and government facilities will improve quality, reduce operations costs, and develop products for both U.S. and foreign military sales; enhance their competitive position and facilities reputation; and reduce government oversight. Finally, the pilot programs will also offer an excellent opportunity to partner with U.S. Army materiel contractors to jointly pursue acquisition reform strategies.

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Development and Engineering Center

Industrial Ecology Center
Product Assurance
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or DSN 880-4071
Fax: 201-724-6759
E-mail: henryv@pica.army.mil
URL: <http://www.pica.army.mil/orgs/eto/top.html>

ISO 14001 Feasibility Initiative. The U.S. Army is evaluating the applicability of the ISO 14001 standard to the facility's existing environmental programs. With assistance from Concurrent Technologies Corporation, this initiative will explore the current status of the environmental programs at the DOD facility, identify the missing ISO 14001 requirements or "gaps" between these programs and the EMS standard; the standard requirements and the associated costs and benefits of modification; and realign and adopt ISO 14001 requirements.

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Air Force ISO 14001 Workshops

A series of ISO 14001 primers and introductory, overview, and implementation workshops for the U.S. Air Force Materiel Command, in conjunction with Concurrent Technologies Corporation, will be initiated. Headquarters and base-level training are to be provided. Training will be specifically directed to DOD requirements and mission-specific activities.

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Concurrent Technologies Corporation
Suite 165
Fairborn, OH 45324

Tel: 513-429-6178
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E-mail: hollings@ctc.com
URL: <http://www.ctc.com>

U.S. Navy EMS Evaluation

The U.S. Navy is evaluating EMS and ISO 14000 as they pertain to Navy operations to identify and quantify any value added by their implementation. This effort will lead to the development of U.S. Navy policy on EMS and/or ISO 14000.

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Naval Surface Warfare Center (NSWC) Carderock ISO 14000 Implementation and Certification

NSWC Carderock is pursuing its first ISO 14000 certification at its Philadelphia site. Gap analysis has been completed and process documentation is underway as of March, 1997. ISO 14000 is being pursued in an attempt to gain competitive advantage, to reduce risk in environmental programs by establishing consistent and repeatable processes, to reduce dependence on personality-driven environmental programs, and to establish a framework for managing environmental impacts.

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E-mail: gutkind@oasys.dt.navy.mil

DEPARTMENT OF ENERGY (DOE)

Energy Facilities Contractors Group (EFCOG) ISO 14000 Working Group

EFCOG is a self-directed group of senior level contractor executives who manage and operate DOE laboratories, manufacturing and production facilities, and environmental restoration projects. EFCOG member companies have joined together for the purpose of exchanging management and technical information in areas of mutual interest. EFCOG's objective is to promote, coordinate, facilitate, encourage, and support information exchanges between facilities on successful programs, practices, procedures, and lessons learned. The ISO 14000 Working Group (ISO 14000 WG) is a working committee whose intent is to facilitate the objectives of EFCOG as related to the particular area of EMS. The purposes of the ISO 14000 WG include promoting excellence in DOE EMS by sharing information and lessons learned, facilitating the exchange of information and experiences in implementing the ISO 14000 series of EMS standards, and communicating the implications for integrating strategic environment, safety, and health management programs into the daily operations at DOE sites. Working group participation will provide EFCOG member companies the opportunity to exchange information and to discuss the benefits of ISO 14000.

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EMS Fact Sheets

DOE's Office of Environmental Policy and Assistance is developing a series of fact sheets addressing topics related to EMS. The fact sheets provide basic information and communicate DOE's approach to EMS issues. Topics in the series consist of frequently asked questions; getting started; EPA's Code of Environmental Management Principles (CEMP); identifying environmental aspects and impacts; and pollution prevention. A PNNL team is supporting the project.

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Environmental Management Systems at DOE

DOE's Office of Environmental Policy and Assistance (EH-41) is actively evaluating uses of the ISO 14001 EMS Standard in improving the environmental sensitivity of DOE operations. This effort comprises an expanding list of activities, such as drafting and releasing a Secretarial memorandum encouraging ISO 14001 use in the field; integrating EMS with DOE's Integrated Safety Management System; preparing EMS guidance documents and fact sheets; raising awareness through panel discussions, invited presentations, conferences, white papers, and briefings; integrating EMS with National Environmental Policy Act (NEPA), pollution prevention, and contract reform; organizing an internal EMS Work Group, a baseline survey of EMS awareness at DOE facilities, ISO 14001 training and technical assistance to sites; working with DOE's Energy Facility Contractor Group and posting a Web site on ISO activities linked to DOE's home page. DOE is also collaborating with EPA on EMS issues. DOE also works with EPA's Office of Federal Facilities Enforcement to produce an EMS Primer for Federal Facilities, co-chairs an EMS Interagency Working Group with EPA's Mary McKiel, and provides review and comment on CEMP, which DOE has endorsed.

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EMS Primer for Federal Facilities

Please see Chapter 2, Headquarters Initiatives, Office of Federal Facilities Enforcement, for full listing.

Implementation of ISO 14001 at Westinghouse-Managed DOE Sites.

Westinghouse is reviewing and modifying its environmental management systems to ensure they conform to the ISO 14001 standard at three sites it manages for the Department of Energy: the Savannah River Site, near Aiken, SC; the West Valley Demonstration Project, near West Valley, NY; and the Waste Isolation Pilot Plant, near Carlsbad, NM. A fourth operation, Safe Sites of Colorado (a Westinghouse and Babcox and Wilcox joint venture), is also working to ensure its EMS conforms to the standard. Safe Sites of Colorado is a subcontractor for Kaiser-Hill, the integrating contractor for the DOE at its Rocky Flats site near Golden, CO.

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E-mail: dupleste@westinghouse.com

Strategic and Program Planning for EMS Initiatives. DOE has been a leader in evaluating uses of the ISO 14001 EMS Standard in improving management of its environmental activities. Initiatives consist of EMS strategic and program planning; linking EMS to other agency initiatives (e.g., integrated Environmental Health & Safety, NEPA, pollution prevention); using ISO 14001 in streamlining internal

directives; analyzing statutory and regulatory impacts; preparing EMS technical materials; developing program and field implementation strategies; developing fact sheets, briefings, and guidance materials; coauthoring technical papers; preparing presentations; and supporting internal and interagency EMS working groups. Since 1994, a PNNL team has provided support in developing these activities.

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DEPARTMENT OF STATE (DOS)

US-Asia Environmental Partnership (US-AEP)

Led by the United States Agency for International Development (USAID), US-AEP was founded in 1992 to assist in addressing environmental degradation and sustainable development issues in the Asia/Pacific region by mobilizing U.S. environmental experience, technology, and practice. The program brings together 25 U.S. government departments and agencies and thousands of businesses and nongovernmental organizations that work with 35 nations and territories in Asia and the Pacific. US-AEP activities focus on the objective of

promoting an Asian "clean revolution" the extensive continuing development and adoption of continuously less polluting and more resource efficient products, processes, and services in the Asian region. While individual US-AEP activities seek practical solutions to local problems, the cumulative effort positively affects global environmental issues.

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US-AEP Clean Technology and Environmental Management Initiative (CTEM). Under this initiative, US-AEP works with Asian governments, industries, professional associations, and trade academic institutions to promote cleaner methods of production. Activities focus on incentives that persuade companies to refine environmental practices; enhancing the capacity of those businesses to respond to incentives; and the transfer of technology that takes advantage of the incentives and capacities within a given business, industrial sector or country. Through consultations, seminars, workshops, and exchanges, these activities promote the understanding and adoption of voluntary standards for corporate environmental management.

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CTEM
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URL: <http://www.usaep.org>

US-AEP Clean Technology and Environmental Management Information Centers (CTEM). CTEM Information Centers provide accurate and timely information to the Asian business community. Each center is staffed with an information specialist who uses in-house print and electronic resources, the Internet, and personal contacts to promote the CTEM concept.

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US-AEP Environmental Exchange Program (EEP). US-AEP's EEP provides Asian professionals and organizations with opportunities for addressing critical environmental needs by identifying sources for U.S. technology, observing and evaluating facilities first-hand for their suitability, meeting with potential partners, and conferring with U.S. government and industry authorities. The program helps link leading ISO 14000 experts in the United States to top 5 industry leaders and environmental professionals in Asia to discuss EMS standards and their implications for industry.

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FOOD AND DRUG ADMINISTRATION (FDA)

Standards Policy Committee

The Standards Policy Committee is composed of senior FDA management officials who set agency-wide policy with respect to the development and use of standards. FDA employees actively participate with a variety of private standards organizations, both domestic and international. FDA develops product standards, criteria for the assessment of test data, and enforcement procedures, and also includes ISO 9000 and ISO 14000 for quality and environment management system registration.

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FEDERAL TRADE COMMISSION (FTC)

Environmental Marketing Claims Guidelines

These 1992 guides are administrative interpretations of laws administered by the FTC to help public comply with the law covering environmental marketing claims. Inconsistent conduct may result in corrective action taken by the FTC under §5 of the FTC Act, which prohibits false or deceptive claims in advertising or labeling. The guidelines focus on what environmental claims mean to consumers and are meant to bolster consumers' confidence in environmental claims and reduce manufacturers uncertainty about which claims might lead to FTC law enforcement actions. The guidelines address general environmental benefit claims and the use of terms such as degradable, recyclable, recycled, source reduction, refillable, and ozone-safe claims.

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Federal Trade Commission
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U.S. POSTAL SERVICE (USPS)

Development of ISO 9000/14000 Protocol for Fleet Maintenance Activities

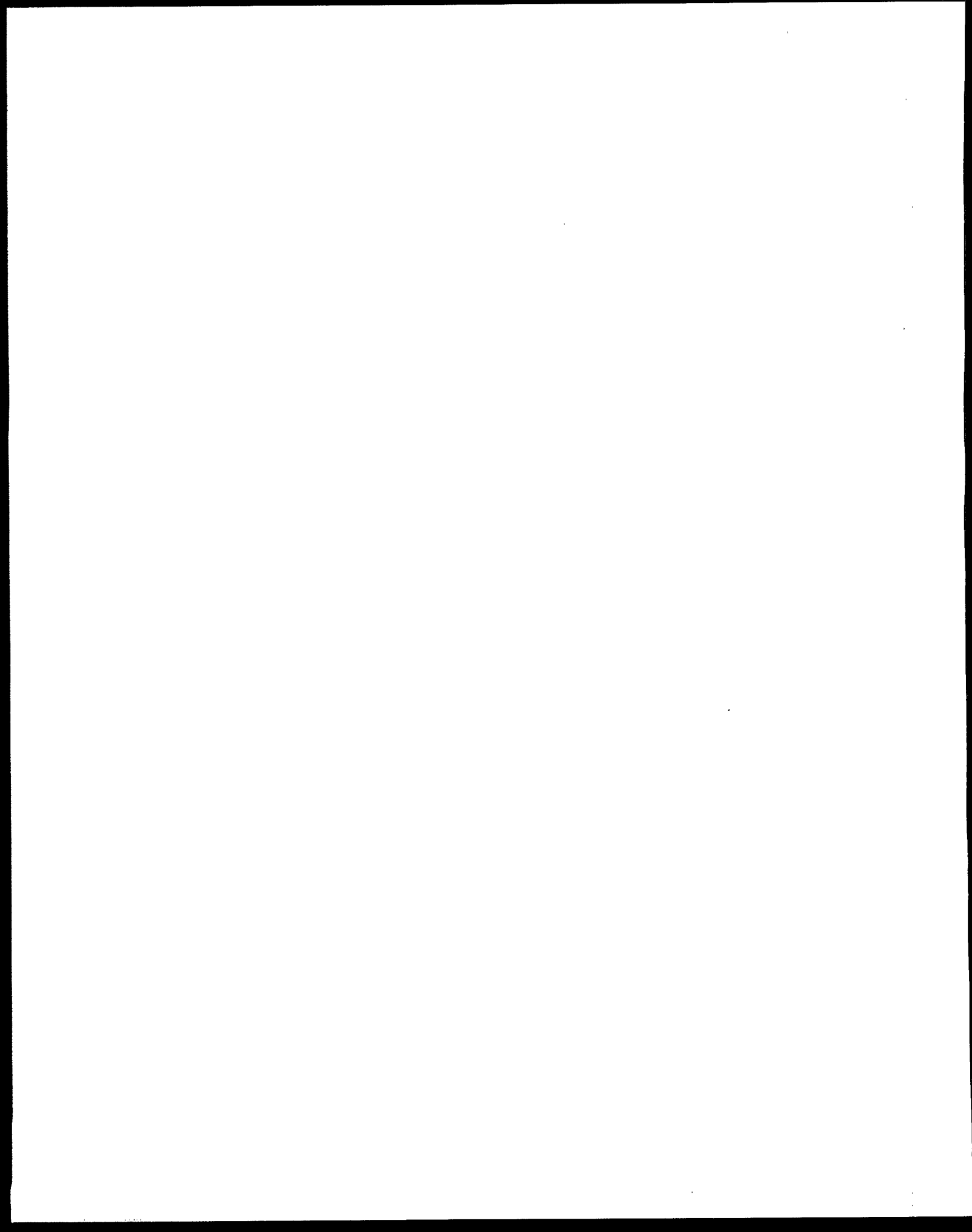
USPS - Southeast Area is in the initial stage of developing an ISO protocol that will blend the quality improvement aspect of ISO 9000 with the environmental improvements associated with ISO 14000.

The USPS's Southeast Area fleet management organization provides operations and maintenance support to approximately 25,000 USPS-owned vehicles assigned throughout a five-state area. By combining ISO 9000 and ISO 14000 protocol, USPS anticipates providing a more uniform, cost effective process of fleet

management while improving the environmentally sensitive aspects of operating a large commercial fleet.

Developing this protocol should begin in early 1997, with "first article" roll out anticipated in Fall 1997.

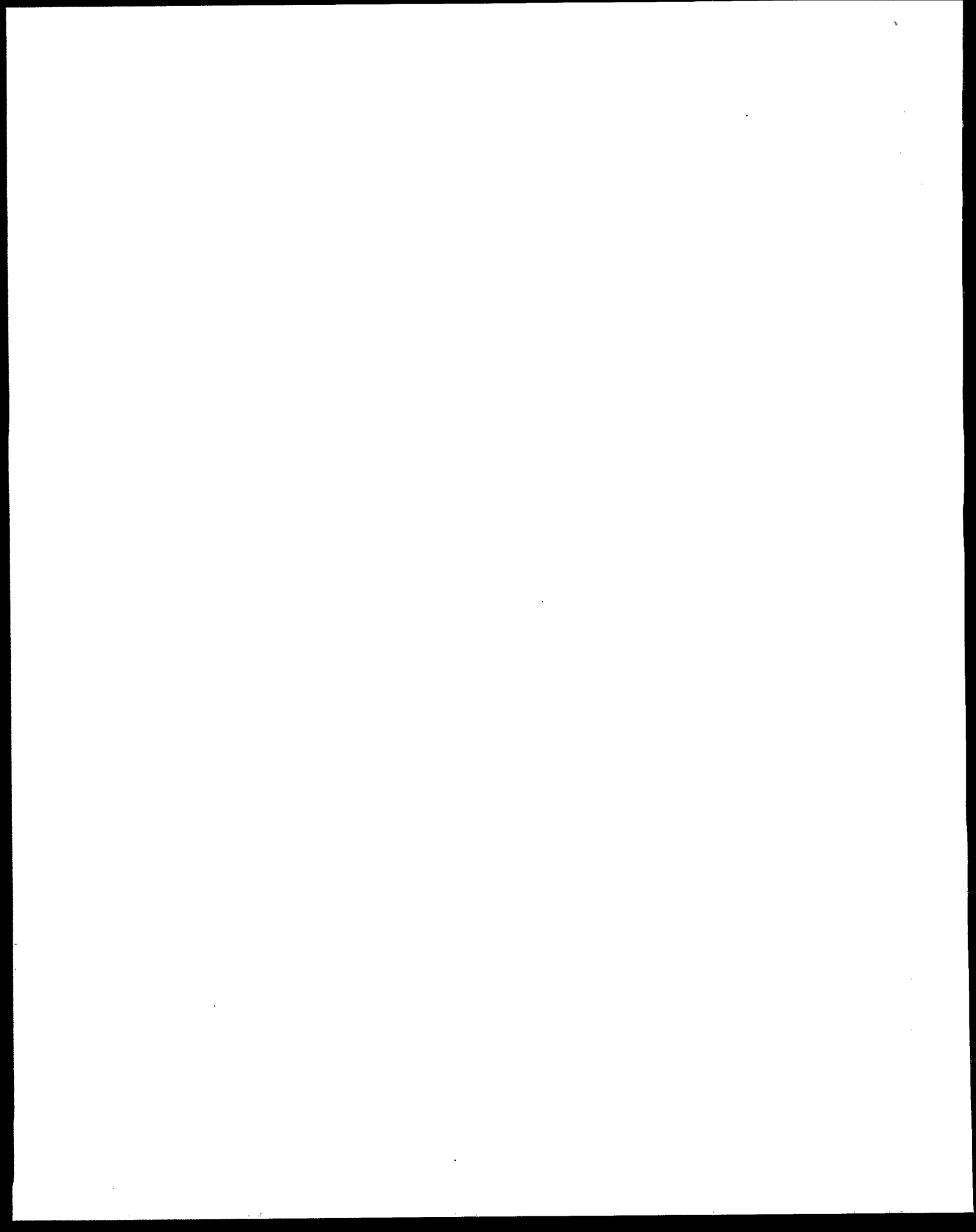
Addr. Robert Martin
Southeast Area Office - USPS
225 N. Humphreys Boulevard
Memphis, TN 38166-0860
Tel: 901-747-7635
Fax: 901-747-7482



4 STATE INITIATIVES

State governments are examining ISO 14000 and its relevance to state environmental compliance and permitting activities. States are also providing technical assistance to organizations interested in ISO 14000. Besides the initiatives directly managed by state governmental agencies, this chapter includes other geographically based initiatives such as those of the national Institute of Standards manufacturing Extension partnership Centers.

1. Alphabetical Listings by State



MULTI-STATE WORK GROUP

The Multi-State Work Group on environmental management systems includes representatives from California, Texas, Oregon, Arizona, Illinois, Minnesota, Wisconsin, Pennsylvania, Massachusetts, and North Carolina. The Work Group has prepared a voluntary project design document, including a Project Evaluation Matrix, which can be used by states and others in the design of projects involving ISO 14001.

Addr: Dr. Robert Stephens
CAL/EPA
Dept. of Toxic Substances Control
Hazardous Materials Laboratory
2151 Berkeley Way, Room 515
Berkeley, CA 94704
Tel: 510-540-3003
Fax: 510-540-2305

ALABAMA

Department of Environmental Management

Alabama is in the preliminary stages of investigating possible application.

Addr: Richard E. Grusnick, Deputy Director
Alabama Department of Environmental
Management
P.O. Box 301463
Montgomery, AL 36130-1463
Tel: 334-271-7710
Fax: 334-271-7950
E-mail: adem@state.al.us

ARKANSAS

ISO 14000 Infrastructure Development

Westark College Business and Industrial Institute is partnering with the Arkansas Department of Pollution Control and Ecology to develop ISO 14000 training. This training will support efforts of Arkansas companies to develop and implement EMS that can be certified to ISO 14000.

Addr: Mike Jones
Westark College
P.O. Box 3649
5210 Grand Avenue
Ft. Smith, AR 72413-3649
Tel: 501-788-7763
Fax: 501-788-7780
E-mail: mjones@systema.westark.edu

CALIFORNIA

CAL/EPA ISO 14000 Pilot Project

CAL/EPA will conduct two to four pilot demonstration projects to test and evaluate the utility of an EMS in achieving and maintaining compliance with regulatory requirements, continuing environmental improvement, and streamlining regulatory procedures.

Addr: Robert Stephens, Chair
CAL/EPA Task Force on ISO 14000
Department of Toxic Substances Control
Hazardous Materials Laboratory
2151 Berkeley Way, Room 515
Berkeley, CA 94704
Tel: 510-540-3003
Fax: 510-540-2305

San Francisco Bay Area Green Business Program

Businesses in full environmental compliance with relevant multimedia regulations (air, land, and water) and meeting program defined, industry-specific standards for energy and water conservation, solid waste reduction, and pollution prevention will be recognized as "green." After local governments certify the company as green, it may then use the program

logo in its advertising to attract environmentally conscious consumers. This program does not include standards for an EMS per se.

Addr: Jennifer Krebs, Senior Environmental Planner
Association of Bay Area Governments
Oakland, CA 94604
Tel: 510-464-7977
Fax: 510-464-7980
E-mail: jenniferk@abag.ca.gov

COLORADO

Pollution Prevention Program

The Colorado Department of Public Health and Environment has included ISO 14000 as a possible criterion in a proposed program that would reduce government oversight and provide financial incentives to companies who excel in environmental performance.

Addr: Parry Burnap
Pollution Prevention Program
OE B2 PPU Colorado Department of Public Health and Environment
4300 Cherry Creek Drive North
Denver, CO 80222-1530
Tel: 303-692-3009
Fax: 303-782-4969
E-mail: parry.burnap@state.co.us

CONNECTICUT

Common Sense Initiative, and StarTrack Pilot Project

As part of EPA's Common Sense Initiative, Environmental Leadership Program and StarTrack Initiatives in Connecticut, the state of Connecticut is participating in pilot projects that focus on EMS and ISO 14000.

Addr: Robert Kaliszewski, Ombudsman
State of Connecticut, DEP
79 Elm Street

Hartford, CT 06106-5127

Tel: 860-424-3003
Fax: 860-424-4077
E-mail: robert.kaliszewski@po.state.ct.us
URL: <http://www.state.ct.us/dep>

DELAWARE

Department of Natural Resources

Delaware is tracking and investigating ISO 14000 activities of other interested states.

Addr: Nicholas A. DiPasquale, Director
Division of Air & Waste Management
Delaware Department of Natural Resources
P.O. Box 1401
89 Kings Highway
Dover, DE 19903
Tel: 302-739-4764
Fax: 302-739-5060
E-mail: ndipasquale@dnrec.state.de.us

FLORIDA

Florida Department of Environmental Protection (FDEP)

EMS help ensure compliance with state and federal regulations and requirements, and can serve as a mechanism to guide improvement in environmental performance. FDEP is working closely with the business community to foster a cooperative spirit of putting well-crafted EMS in place.

Addr: Michael Phillips
FDEP
3900 Commonwealth Boulevard (18)
Tallahassee, FL 32399-3000
Tel: 904-921-9717
Fax: 904-488-7093
E-mail: phillips_M@epic9.dep.state.fl.us

URL: <http://www.dep.state.fl.us>

GEORGIA

Pollution Prevention Assistance Division (P2AD)

P2AD provides industry within the state information regarding ISO 14000. This is done through P2AD newsletters, assessments, and participation in industry conferences.

Addr: **Matt Barcaskey**
Georgia P2AD
7 Martin Luther King, Jr. Drive,
Suite 450
Atlanta, GA 30334
Tel: 404-651-5120
Fax: 404-651-5130
E-mail: p2ad@ix.netcom.com
URL: <http://www.dnr.state.ga.us>

IDAHO

Idaho Manufacturing Alliance

The executive director currently conducts ISO 14000 training workshops across the state of Idaho.

Addr: **Jim Steinfort**, Executive Director
Idaho Manufacturing Alliance
Boise State University
1910 University Drive
Boise, ID 83725
Tel: 208-385-3689
Fax: 208-385-3877
E-mail: jsteinf@idbsu.bsui.edu

INDIANA

Small Business Pilot Project

The Indiana Department of Environmental Management (IDEM) and EPA plan to undertake

three to five pilot projects as part of the thermoset plastics sector of the Sustainable Industry Project. The project has three distinct goals: 1) to identify the problems faced by small businesses trying to implement an EMS, 2) to identify the infrastructure and support needed by small businesses for EMS implementation, and 3) to demonstrate a new regulatory regime for small businesses.

IDEM and EPA have identified project resources to help small businesses through the project, including a) an IDEM grants program that in place will help offset some of the costs in implementing an EMS; b) technical assistance from IDEM's Compliance and Technical Assistance Program; c) additional technical assistance from the Indiana Pollution Prevention and Safe Materials Institute at Purdue University; d) regional EPA technical assistance from EPA Region 5; and, e) reporting and permitting flexibility from IDEM and EPA.

Addr: **Marc Hancock**
Indiana Department of Environmental
Management
100 North Senate Avenue
P.O. Box 6015
Indianapolis, IN 46206
Tel: 317-233-1043
Fax: 317-233-5627
E-mail: mhanc@opn.dem.state.in.us
URL:
<http://www.epa.gov/oppe/isd/indiana.htm>

Addr: **Carl Koch**
U.S. EPA, OPPE
401 M Street, SW
Washington, DC 20460
Tel: 202-260-2739
Fax: 202-260-9322
E-mail: koch.carl@epamail.epa.gov
URL: <http://www.epa.gov/oppe/isd/isd.htm>

IOWA

Iowa Waste Reduction Center (IWRC) EMS Assistance Program

The IWRC provides ISO 14001 EMS development assistance to small businesses in Iowa.

Addr: Marci Carter
University of Northern Iowa
75 Biology Research Complex
Cedar Falls, IA 50614-0185
Tel: 319-273-2079
Fax: 319-273-2926
E-mail: carterm@uni.edu
URL: <http://www.iwrc.uni.edu>

Waste Reduction Assistance Program (WRAP)

Through on-site assessments, workshops, and continual support, WRAP provides nonregulatory, confidential, no-cost assistance designed to reduce wastes and enhance a company's bottom line. The program targets Iowa business and industry with more than 100 employees or those classified as RCRA large quantity generators.

Addr: Beth Hicks
Iowa Department of Natural Resources
900 East Grand Avenue
Des Moines, IA 50309
Tel: 515-281-8927
Fax: 515-281-8895
E-mail: ehicks@max.state.ia.us.
URL: <http://www.recycleiowa.org>

KANSAS

Environmental Management System

K.S.A. 60-332 et seq., enacted by the 1995 Kansas legislature, outlines the components of an EMS. If a finding of violation occurs, a facility that has implemented an EMS is afforded

consideration by the court or administrative tribunal in determining whether to impose an administrative, civil, or criminal penalty and the severity of the penalty. The Kansas Department of Health and Environment is actively encouraging facilities to implement EMS.

Addr: Theresa Hedges
Kansas Department of Health and Environment
Office of Science and Support
Building 283, Forbes Field
Topeka, KA 66620
Tel: 913-296-6603
Fax: 913-291-3266

KENTUCKY

Kentucky Pollution Prevention Center's (KPPC) ISO 14000 Awareness

KPPC is facilitating ISO 14000 training through contractors, partnerships with other assistance providers, and by downlinking national teleconferences. It has sponsored/presented two 2-day workshops in Louisville and Lexington, KY. In addition, two 3-hour teleconferences were downlinked in those two cities in October 1996. A presentation titled "An Overview of ISO 14000" has been offered at conferences and lecture series statewide. KPPC will continue to provide training opportunities for Commonwealth business as well as further identify its role in ISO 14000 implementation.

Addr: Cam Metcalf, Executive Director
Kentucky Pollution Prevention Center
420 New Academic Building
University of Louisville
Louisville, KY 40292
Tel: 502-852-0965
Fax: 502-852-0964
E-mail: jcmetc01@ulkyvm.louisville.edu
URL: <http://www/louisville.edu/org/kppc>

LOUISIANA

Department of Environmental Quality

Environmental Leadership/ISO 14000. The Louisville Department of Environmental Quality (LDEQ) Office of Secretary is developing an Environmental Leadership Program/ISO 14000 initiative for Louisiana's business and industry. A coordinator provides consultation and workshops to educate interested parties regarding U.S. government policy regarding ISO 14000, including environmental management systems (EMS).

Addr: **Gary Johnson/Hugh Finklea**
Louisiana Department of
Environmental Quality
P.O. Box 82263
Baton Rouge, LA 70884-2263
Tel: 504-765-0720
Fax: 504-765-0742
E-mail: gary_j@deq.state.la.us

Environmental Leadership Pollution Prevention Program

This is a cooperative effort between the Louisiana Department of Environmental Quality and Louisiana's industry that encourages companies to assume environmental leadership roles by committing to minimizing their waste streams in all media, and participating in activities to enhance Louisiana's environment.

Addr: **Charles Killebrew, Technical Manager**
Technical Program Support Section
Louisiana Department of
Environmental Quality
Office of the Secretary
P.O. Box 82263
Baton Rouge, LA 70884-2263
Tel: 504-765-0720
Fax: 504-765-0742

MAINE

Department of Environmental Protection (DEP)

As a component of the state's Environmental Excellence: Maine Program, DEP works with businesses developing EMS (including ISO 14000) to review gap analyses and provide compliance assistance and regulatory review as the plans are developed.

Addr: **Ron Dyer**
Maine DEP
STP #17
Augusta, ME 04333
Tel: 207-287-2811
Fax: 207-287-2814
E-mail: ron.e.dyer@state.me.us

Center for Technology Transfer (CTT)

Environmentally Conscious Manufacturing (ECM) Program. CTT is a private nonprofit organization that works primarily with Maine's metals and electronics industries to enhance their competitiveness through training, technology transfer, and technical assistance. ECM is one of CTT's focus areas; pollution prevention assessments, training, development literature, conferences, and seminars were all initiated under this program over the last 2 years. CTT will work with its target industries to educate companies on EMS and why they may or may not want to become certified to ISO 14001.

Addr: **Mark Arienti, P.E., Field Engineer**
ECM Project
Center for Technology Transfer
190 Riverside Street
Portland, ME 04103
Tel: 207-871-8254
Fax: 207-780-1547
E-mail: marienti@mstf.org
URL: <http://www.ctt.org>

EMS Development for Industry - Electric Power Sector

The Central Maine Power Company and the Natsionalna Elektricheska Kompania of Bulgaria are working on a U.S. AID-funded effort to develop EMS for major power plants in Bulgaria and for the central electric utility system. Bulgaria has adopted environmental standards similar to those of western Europe and the United States, however, both the plant equipment and the management systems are dated in terms of being able to meet these standards. This initiative will help the management side of environmental businesses. One major power plant was selected for system development; at the discretion of the Natsionalna Elektricheska Kompania, the EMS techniques will be transferred to the rest of the system.

Addr: **James H. Wazlaw**
Central Maine Power International
One Grandview Place
Winthrop, ME 04364
Tel: 207-626-9749
Fax: 207-626-959

Addr: **Hristo Shwabsky**
Natsionalna Elektricheska Kompania
Sofia, Bulgaria
Tel: 359 2 980 1968
Fax: 359 2 875826
E-mail: nek.s.msp@mcr1.poptel.org.uk

Addr: **Dr. Robert Ichord, Jr.**
U.S. AID
320 21st Street NW
Washington, DC 20523
Tel: 202-647-6962
Fax: 202-647-8274

(Cross-listed with International Initiatives,
chapter 6)

MARYLAND

Maryland Department of the Environment (MDE)

MDE conducts various ISO 14000 training programs for management and field personnel.

Addr: **Mitch McCalmon**
Maryland Department of the
Environment
2500 Broening Highway
Baltimore, MD 21224
Tel: 410-631-4499
Fax: 410-631-3896

ISO 14000 Awareness for Maryland Manufacturers

Various agencies, public and private organizations in Maryland are making significant strides in identifying and providing ISO 14000 related information and awareness training throughout Maryland. The Environmental Engineering Program of the University of Maryland's Engineering Research Center (ERC) has begun an initiative to assist these efforts, identifying potentially interested participants, promoting the program, and assisting with presentation as requested. Primary efforts to date have been with the regional offices of the ER's Technology Extension Service (an affiliate of the Maryland NISTMEP), the Maryland Department of the Environment, and various local technology councils.

Addr: **Paul Gietka**
University of Maryland at Baltimore
618 West Lombard Street, 1st Floor
Baltimore, MD 21201
Tel: 410-706-3233
Fax: 410-706-3446
E-mail: pg26@umail.umd.edu

MICHIGAN

Clean Corporate Citizen Program

This program gives businesses tangible incentives and benefits, such as faster permits, expanded construction and operational waivers, and plantwide applicable limits for air permits. Such benefits are attainable by meeting three criteria: 1) a demonstrated commitment to reduce waste through a pollution prevention program; 2) consistent compliance with all environmental requirements and no outstanding unresolved violations; and 3) a strong and effective EMS such as ISO 14001.

Addr: **Robert Basch**, Chief
Technical Assistance Section,
Environmental Assistance Division
Department of Environmental Quality
P.O. Box 30457
Lansing, MI 48909-7957
Tel: 517-335-7161
Fax: 517-373-3675
E-mail: baschr@deq.state.mi.us

MINNESOTA

Office of Attorney General

EMS Training. The initiative involves two projects designed to improve EMS training. The first project involves a series of ten seminars on various aspects of environmental management including ISO 14000; the primary audience is larger businesses. The second project focuses on smaller businesses and will include five separate training sessions that incorporate environmental management elements into small business manufacturing excellence programs.

Banking/Insurance Initiative. This is an effort to identify the risk reduction and competitiveness advantages of good EMS and to inform bankers, insurers, and investors of these advantages. ISO 14000 certification and implementation could conceivably be used as a tool in measuring likely improved performance.

Addr: **Lee Paddock**
Office of Attorney General
900 NCL Tower
445 Minnesota Street

St. Paul, MN 55101-2127
Tel: 612-296-6597
Fax: 612-297-4139
E-mail: lee.paddock@state.mn.us

MISSOURI

ISO 14000 Cooperation Project

This project supports research and educational activities within Missouri state government and with nongovernmental groups, including a joint relationship with the National Center for Environmental and Information Technology in St. Louis.

Addr: **Steve Mahfood**
Missouri Environmental Improvement
and Energy Resources Authority
P.O. Box 744
325 Jefferson
Jefferson City, MO 65101
Tel: 573-751-4919
Fax: 573-635-3486

NEBRASKA

Department of Environmental Quality (NDEQ)

Quality Assurance Implementation for Technical Policy and Independent Technical Oversight of Low Level Radioactive Wastes Application. NDEQ has the regulatory oversight and licensing authority, in conjunction with the Nebraska Health and Human Services (HHS), for licensing commercial low level waste disposal under 10XFR Part 61 in the state of Nebraska. NDEQ was charged with license review and independent technical assessment under NDEQ title 132 and NDOH Title 180. NDEQ developed a comprehensive quality assurance program using NUREG 1293/NUREG 1383 and NQA-1. The program incorporates requirements to address NRC Reg. Guide 415. Over a seven year period, the quality assurance implementation has been successfully

implemented to over 200 personnel and covers all elements of technical review and oversight process. NDEQ has successfully implemented a "graded approach" to audits and surveillance that had never been implemented to this level for license review. It is unique for government oversight for state regulatory license review.

Addr: Jay D. Ringenberg, LLRW Program Manager
Nebraska Department of
Environmental Quality
P.O. Box 98922
1200 N Street, Suite 400, The Atrium
Lincoln, NE 68509-8922
Tel: 402-471-3372
Fax: 402-471-2909

NEW HAMPSHIRE

New Hampshire Pollution Prevention Program (NHPPP)

This nonregulatory pollution prevention program offers technical assistance services such as conferences and workshops, information requests, onsite assistance, pollution prevention information clearinghouse, internships, educational curricula, pollution prevention regulatory integration, and strategic partnerships.

Addr: Vincent R. Perelli, NHPPP Manager
New Hampshire Department of
Environmental Services Pollution
Prevention Program
6 Hazen Drive
Concord, NH 03301-6509
Tel: 603-271-2902
Fax: 603-271-2456
E-mail: perelli@deswmdpl.mv.com

NEW MEXICO

Green Zia Environmental Excellence Program

The Green Zia program will recognize businesses, institutions, and governmental entities that have met specific criteria for achieving environmental excellence: 1) long-term compliance with all environmental regulations and development of a pollution prevention plan; 2) achievement of specified pollution prevention goals outlined in the plan; and 3) achievement of additional goals and mentorship in pollution prevention technologies for other businesses, institutions or governmental entities. The criteria for receiving recognition will be developed with input from regulators and industry representatives, and will include ISO 14000 conformance. The program should be implemented in mid-1997.

Addr: Judy Kowalski
Forestry and Resources Conservation
Division
Energy, Minerals, and Natural
Resources Department
P.O. Box 1948
Santa Fe, NM 87504-1948
Tel: 505-827-7474
Fax: 505-827-3903
E-mail: jkowalski@emnrdsf.state.nm.us

NEW YORK

ISO 14000 Regulatory Integration Pilot Program

The Department of Environmental Conservation is developing two pilot projects with one small business and one large business to explore how ISO 14000 certification can be incorporated into regulatory oversight programs.

Addr: William Eberle
NYSDEC
50 Wolf Road
Albany, NY 12233-8010
Tel: 518-457-2553
Fax: 518-457-2570

NORTH CAROLINA

The North Carolina Department of Environment, Health and Natural Resources

Environmental Management Systems. The North Carolina Department of Environment, Health and Natural Resources has formed a workgroup to look at the use of EMS. Specifically, the group will be involved in pilot projects, internal training, gaining support of external groups, and policy development.

Addr: Ravila Gupta
North Carolina Department of
Environment, Health and Natural
Resources
P.O. Box 29569
Raleigh, NC 27626
Tel: 919-715-6507
Fax: 919-715-6794
E-mail: ravila_gupta@owr.ehnr.state.nc.us

ISO 14000 Workgroup for the National P2 Roundtable. The first official meeting of this group was held in November 1996 as part of the National Pollution Prevention (P2) Roundtable's regular workgroup meetings. Some example issues addressed were: How can P2 mesh with the standard? Will P2 be included in the auditor training and if so, how? What is the role of technical assistance personnel? Can small- and medium-sized manufacturers benefit from ISO 14000 and what are some of their implementation issues? Will the standard lead to source reduction? This workgroup will generate and maintain an ISO 14000 e-mail list.

Addr: Ravila Gupta
P.O. Box 29569
Raleigh, NC 27626
Tel: 919-715-6507
Fax: 919-715-6794
E-mail: ravila_gupta@owr.ehnr.state.nc.us

Addr: Krista Johnsen Leuteritz
NIST/MEP
Building 301, Room C-100
Gaithersburg, MD 20899
Tel: 301-975-5104
Fax: 301-926-3787
E-mail: kristin.johnsen@nist.gov
URL: <http://www.mep.nist.gov/>

NORTH DAKOTA

Wetland Conservation Strategy

This multifunctional program includes a variety of incentive programs and demonstrations to encourage restriction and preservation of the state's substantial wetland resources.

Addr: Lee Klapprodt
North Dakota State Water
Commission
900 East Bird
Bismarck, ND 58501
Tel: 701-328-2750
Fax: 701-328-3696
E-mail: lklap@water.swc.state.nd.us
URL: <http://water.swc.state.nd.us>

OHIO

ISO 14000 Information Gathering

The Ohio Office of Pollution Prevention is presently gathering information about the ISO 14000 series of voluntary standards.

Addr: Andrea Futrell
Ohio EPA
Office of Pollution Prevention
P.O. Box 1049
Columbus, OH 43216-1049
Tel: 614-644-2813
Fax: 614-726-1245
E-mail: andrea_futrell@central.epa.ohio.gov
URL: <http://www.epa.ohio.gov/opp/>

OKLAHOMA

Department of Environmental Quality

The Pollution Prevention Program provides technical assistance to business and industry across the state of Oklahoma. It also houses a clearinghouse of up-to-date information on pollution prevention advances in various industries, reference materials, and journals. ISO 14000 activities consist of educating program members about the standards.

Addr: **Leisa Smith**
Oklahoma Department of
Environmental Quality
1000 NE 10
Oklahoma City, OK 73117-1212
Tel: 405-271-1400 or 800-869-1400
Fax: 405-271-1317

OREGON

Environmental Action Agreement Project

The Department of Environmental Quality's Pollution Prevention Core Committee is developing the framework of a program that will provide regulatory incentives for companies that demonstrate environmental performance beyond that required by law. Details of how companies qualify for participation and what types of rewards will be offered are still being determined. In order to qualify to be part of the Environmental Action Agreement Project, participants must have 1) an EMS in place that assures compliance with mandated environmental requirements, 2) some supplemental activities that demonstrate protection of the environment beyond that required by law, and 3) some mechanism for public communication about the facility's environmental performance.

Possible rewards include both a recognition program and some regulatory relief, such as expedited permit processing, reduced monitoring and reporting frequency, and enforcement discretion. A workgroup will convene to develop these ideas and develop recommendations for turning pilot efforts into a full-scale incentive program.

Addr: **Holly Schroeder**
DEQ Northwest Region
2020 SW Fourth Avenue
Portland, OR 97201
Tel: 503-229-5585
Fax: 503-229-6945
E-mail: holly.schroeder@state.or.us
URL: <http://www.deq.state.or.us>

Addr: **Marianne Fitzgerald**, Coordinator
DEQ Pollution Prevention
811 SW Sixth Avenue
Portland, OR 97204
Tel: 503-229-5946
Fax: 503-229-5850
E-mail: marianne.fitzgerald@state.or.us
URL: <http://www.deq.state.or.us>

PENNSYLVANIA

Strategic Environmental Management: Beyond Compliance

Strategic Environmental Management is a regulatory approach that incorporates ISO 14001 environmental accounting, full life-cycle assessment, and performance measurements into a pollution prevention approach to environmental management.

Addr: **Marylou Barton**
Department of
Environmental Management
Rachel Carson State Office Building
P.O. Box 8464
Harrisburg, PA 17105-8464
Tel: 717-787-7060

Fax: 717-787-9378
E-mail: barton.marylou@al.dep.state.pa.us
URL: <http://www/dep.state.pa.us>

Market-Based Audits of EMS: Implementing ISO 14000

Those conducting the project are studying four interrelated hypotheses concerning ISO 14000: 1) ISO 14000 will improve public knowledge and reduce acceptability of industrial activities with environmental impacts; 2) ISO 14000 will improve internal management capabilities and reduce compliance costs for companies over other environmental management alternatives; 3) ISO 14000 will improve risk management practices and will lead to better relations with insurers and a risk managers and to lower premiums for certified companies; and 4) ISO 14000 will lead to decreased transaction costs of regulation, both at the state and federal level. A series of pilot studies in Wisconsin and Pennsylvania are planned to test these hypotheses.

Addr: Paul R. Kleindorfer
Wharton Risk Management and
Decision Processes Center
University of Pennsylvania/Wharton
School
1325 Steinberg-Dietrich Hall
3620 Locust Walk
Philadelphia, PA 19104-6366
Tel: 215-898-5688
Fax: 215-573-2130
E-mail: kleindorfer@wharton.upenn.edu
URL: <http://opim.wharton.upenn.edu/risk/>

Pennsylvania Environmental Council

The Pennsylvania Environmental Council is a statewide education, advocacy, and policy nonprofit organization that is promoting discussion of ISO 14000 in Pennsylvania through several mechanisms, including publication of related articles in a quarterly newsletter and hosting discussion groups with

representatives of government, business, industry, and environmental interests.

Addr: Joanne R. Denworth
1211 Chestnut Street, Suite 900
Philadelphia, PA 19107
Tel: 215-563-0250
Fax: 215-563-0528
E-mail: pecphila@libertynet.org
URL: <http://www.libertynet.org/~pecphila>

TENNESSEE

Department of Environment and Conservation (TDEC)

TDEC is following the development of the ISO 14000 standards and potential uses. In addition, TDEC is participating, as an Environmental Council of States (ECOS) representative, in EPA's ISO 14000/EMS Task Group.

Addr: David L. Harbin, Assistant General
Counsel
Department of Environment and
Conservation
Office of General Counsel
L & C Tower, 20th Floor
401 Church Street
Nashville, TN 37243-1548
Tel: 615-532-0144
Fax: 615-532-0145
E-mail: ddharbin@mail.state.tn.us

TEXAS

Office of Pollution Prevention and Recycling

The Office currently oversees multiple projects analyzing EMS and its application. These projects include analyzing potential inspection protocols to incorporate EMS, analyzing the relationship between EMS and environmental economic performance in industrial facilities, and incorporating EMS into voluntary recognition/incentive programs.

Addr: Andrew Neblett, Director
Office of Pollution Prevention and
Recycling
Texas Natural Resource Conservation
Commission
P.O. Box 13087 (MC 112)
Austin, TX 78711-3807
Tel: 512-239-3166
Fax: 512-239-3165
E-mail: aneblett@tnrcc.state.tx.us

UTAH

Department of Environmental Quality (DEQ)

Utah's pollution prevention program serves as the contact point for promotion and dissemination of information related to ISO 14000. The pollution prevention program will notify other DEQ divisions and industrial groups and also serve as a contact for communicating with these groups regarding ISO 14000.

Addr: Sonja F. Wallace
Utah Department of Environmental
Quality
168 North 1950 West
Salt Lake City, UT 84114-4810
Tel: 801-536-4477
Fax: 801-536-0061
E-mail: eqoas.swallace@state.ut.us

VERMONT

Vermont Manufacturing Extension Center (VMEC)

VMEC is a NIST-MEP center serving the technical assistance needs of Vermont's manufacturers.

Addr: Muriel Durgin, Director

Vermont Manufacturing Extension
Center
P.O. Box 500
Randolph Center, VT 05061-0500
Tel: 802-728-1312; in VT 800-MEP-
4MFG
Fax: 802-728-1456
E-mail: vmec@night.vtc.vsc.edu
URL: <http://www.vmec.org>

VIRGINIA

Department of Environmental Quality

Virginia is tracking and investigating ISO 14000 activities of other interested states.

Addr: T. March Bell
Department of Environmental Quality
P.O. Box 10009
Richmond, VA 23240-0009
Tel: 804-698-4417
Fax: 804-698-4019

WASHINGTON

Department of Ecology

Compliance Assurance and Environmental Audits. Several "Beyond Compliance" related initiatives that relate to ISO 14000 exist, including an EPA ISO 14000 task group, an environmental leadership program, and a performance based permits system.

Addr: Greg Sorlie, Program Manager
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
Tel: 360-407-6977
Fax: 360-407-6902
E-mail: gsor461@ecy.wa.gov

Addr: John Williams, Staff
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Tel: 360-407-6968
Fax: 360-407-6902
E-mail: jowi461@ecy.wa.gov

ISO 14000 Leadership Project. This project is sponsored by EPA Region 10 and the Washington State Department of Ecology, working in conjunction with the International Standards Initiative, to clarify the environmental, economic, and regulatory benefits of ISO 14001 certification. The project comprises four tasks: 1) focus group discussions, 2) discussion forum, 3) EMS analysis, and 4) final report.

Addr: **Tom Eaton**, Special Assistant to the
Director for Pollution Prevention
Department of Ecology
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Fax: 360-407-6989
E-mail: teat461@ecy.wa.gov

Addr: **John Palmer**, Pollution Prevention
Manager
U.S. EPA Region 10
P.O. Box 1202
1200 6th Avenue (01-085)
Seattle, WA 98101
Tel: 206-553-6521
E-mail: palmer.john@epamail.epa.gov

Addr: **K.C. Ayers**, Executive Director
International Standards Initiative
P.O. Box 1202
Issaquah, WA 98027-1202
Tel: 206-392-7610
Fax: 206-392-7630
E-mail: kcayers@isi-standards.org
URL: <http://www.isi-standards.org>

WISCONSIN

Wisconsin ISO 14000 Working Group

This group is composed of members of the public and private sector with extensive knowledge of ISO 14000. A number of interim reports have been developed by the group and will form the basis for a pilot study. The pilot effort of the Wharton/LaFollette project will be the same pilot effort as the Wisconsin ISO 14000 Working Group project. Companies are expected to begin participating in 1997.

Addr: **Tom Eggert**
Wisconsin Department of Natural
Resources
P.O. Box 7921 MB/5
Madison, WI 53707
Tel: 608-267-2761
Fax: 608-267-5231
E-mail: eggert@dnr.state.wi.us

Wharton/LaFollette Joint Research Effort

The states of Wisconsin and Pennsylvania are working together with the Wharton Business School and the LaFollette Institute of Public Affairs to identify cost, benefits, and public policy issues of ISO 14000. The research will be supplemented by a pilot study, which will test out assumptions and theories.

Addr: **Jeff Smoller**
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Tel: 608-267-5231
Fax: 608-267-5231
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Addr: **Paul R. Kleindorfer**
Wharton Risk Management and
Decision Processes Center
University of Pennsylvania/Wharton
School
1325 Steinberg-Dietrich Hall
3620 Locust Walk
Philadelphia, PA 19104-6366
Tel: 215-898-5830

Fax: 215-573-2130
E-mail: kleindorfer@wharton.upenn.edu
URL: <http://opim.wharton.upenn.edu/risk/>

5 NONPROFIT INITIATIVES

The nonprofit organizations in this chapter are divided into three sections. An *industry* section lists organizations that promote communication about ISO 14000 in their respective industry sectors. The section on *nongovernmental* initiatives includes nonprofit organizations representing stakeholders with an interest in improved environmental performance, as well as nonprofit organizations that directly provide ISO 14000 related services. Initiatives based at *academic* institutions includes training services, consulting services and the application of the ISO 14000 standards to the academic institutions themselves.

- 1. Industry Associations and Networks**
- 2. Nongovernmental Organizations**
- 3. Academic Organizations**

INDUSTRY ASSOCIATIONS

Air & Waste Management Association (AWMA) Intercommittee Task Force on ISO 14000

AWMA's Intercommittee Task Force on ISO 14000 will cosponsor an international forum, in conjunction with the AWMA 1997 Annual Conference, to be held in June 1997. The forum, entitled AISO 14000 Environmental Management Systems: Where we've been and where we're going, @ will be held in Toronto, Canada.

Addr: George D. Greenly, Jr., CCM, QEP
Battelle-Pantex
6900 I-40 West, Suite 130
Amarillo, TX 79106
Tel: 806-353-4198
Fax: 806-353-4628
E-mail: ggreenly@pantex.com
URL: <http://www.awma.org>

American Petroleum Institute

Strategies for Today's Environmental Partnership (STEP). STEP represents the petroleum industry's collective initiatives to improve petroleum industry environmental, health, and safety (EHS) performance, document and communicate its achievements, and improve the public's understanding of its performance. STEP provides a unifying framework, through the American Petroleum Institute (API), that the industry can use to improve EHS performance in a flexible, yet systematic manner; to share best practices; to enhance operating efficiencies and reduce costs; and to document performance improvements.

Many companies, working collectively and individually, have successfully used management systems approaches to accomplish cost-effective improvements on an ongoing basis. Individual company and industry EHS performance and efficiency are expected to improve as a result of successful implementation of EHS management systems, an expectation that several API members with EHS management systems have affirmed. Based on these successes, API promotes the use of flexible EHS management systems, which provide a means for integrating EHS management into everyday business operations, regardless of company size. API is developing a template for an EHS management system that can be used by its members as a guide for their own systems.

Addr: Walter C. Retzsch
American Petroleum Institute
1220 L Street, NW
Washington, DC 20005
Tel: 202-682-8598
Fax: 202-682-8579
E-mail: step@api.org
URL: <http://www.api.org/step/>

American Society for Quality Control (ASQC)

Energy and Environmental Division (EED). EED produced the first American national standard on quality assurance for environmental programs, ANSI/ASQC E4-1994. Members are active on several ISO Technical Committees, including TC 176 and TC 207. EED has been an active participant in the development of the ISO 14000 series of EMS.

Addr: John Dew, Vice-Chair
Administrative Services
Lockheed Martin Utilities Services
P.O. Box 1410
Paducah, KY 42001
Tel: 502-441-6759
Fax: 502-441-6103

E-mail: dewjr@ornl.gov

Electronic Industries Association (EIA)

EIA has organized a variety of educational programs to provide information to members concerning strategic and practical considerations applicable to ISO 14000. These education programs include presentations, seminars, and documents.

Addr: David Isaacs
Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201-3834
Tel: 703-907-7576
Fax: 703-907-7501
E-mail: disaacs@eia.org
URL: www.eia.org

The Associated Industries of Massachusetts/Massachusetts Manufacturing Partnership ISO 14000 Collaborative

The Associated Industries of Massachusetts is working with the Massachusetts Manufacturing Partnership to provide companies with a comprehensive program designed to prepare for ISO 14000 registration. The ISO 14000 Collaborative is an innovative program that provides small manufacturers with the opportunity to prepare for registration at an affordable price. The program is led by world class corporate education professionals experienced in ISO 14000 training who follow a proven method of interactive instruction over a period of 12 to 14 months.

Addr: Beverly Cadorette
Massachusetts Manufacturing
Partnership
Corporation for Business, Work, and
Learning

101 Summer Street
Boston, MA 02110

Tel: 617-292-5100, ext. 285
Fax: 617-292-5105
E-mail: bcadorette@mmp.bssc.org
URL: http://www.mmpmfg.org

National Association of Environmental Professionals (NAEP)

ISO 14000 Working Group. The NAEP ISO 14000 Working Group is composed of NAEP members from government, industry, the financial community, and the consulting field with an interest in the development and implementation of ISO 14000 standards. The group's mission is threefold: 1) to participate in the development and implementation of the ISO 14000 standards; 2) to promote and facilitate communication among environmental professionals on the impacts of these standards; and 3) to promote the integration of NAEP ethics, principles, interests, and practices into the standards.

Addr: Phil Stapleton, Chair
Glover-Stapleton Associates
NAEP
1627 K Street, NW
Washington, DC 20006
Tel: 202-331-9659
Fax: 202-296-6270
URL: http://enfo.com/NAEP

Industrial Designers Society of America (IDSA)

Environmental Responsibility Section. IDSA's Environmental Responsibility Section is dedicated to the exploration of environmentally responsible design solutions and product management systems. The tools being explored include Life Cycle Modeling, Design for the Environment, Integrating Design with the EMS

of ISO 14000, and other strategies that may move society toward a sustainable future.

Addr: John Paul Kusz, IDSA
301 South Home Avenue
Park Ridge, Illinois 60068
Tel: 847-692-9590
Fax: 847-692-9590
E-mail: jpkusz@aol.com

Northeast Business Environmental Network (NBEN)

The Forum for Best Management Practices.

The forum will serve as a network providing examples of best practices for pollution prevention and compliance management. Examples include the EPA self-policing guidelines and ISO 14001. Participants exchange their best practice examples based on a summary model consisting of ten basic features; the best of these examples will be summarized and annotated in a manual to be published by NBEN and posted to NBEN's Web page. NBEN fosters sustainable development through the exchange of practical information in regular meetings, seminars, and over the Internet. Raytheon hosted a conference discussing the forum on November 15, 1996, in Lexington, MA.

Addr: Jennifer Hill
NBEN
56 Island Street
Lawrence, MA 01842
Tel: 508-557-5475
Fax: 508-557-5493
E-mail: execdirector@nben.org
URL: <http://www.nben.org>

National Center for Manufacturing Sciences (NCMS)

NCMS is a membership organization best described as a consortium of North American manufacturing organizations whose main activity is to put together and manage cooperative research projects among its member companies.

Addr: Paul Chalmer
NCMS
3025 Boardwalk Drive
Ann Arbor, MI 48108-3266
Tel: 313-995-4911
Fax: 313-995-1150
E-mail: paul.chalmer@ncms.org
URL: <http://www.ncms.org>

NON- GOVERNMENTAL ORGANIZATIONS

Alliance for Environmental Innovation

The Alliance for Environmental Innovation is a project of the Environmental Defense Fund and the Pew charitable trusts. The alliance will develop projects that 1) implement measurable actions to reduce waste, prevent pollution, and conserve resources while enhancing business performance; and 2) create actionable models and methodologies for other businesses to adopt.

Each project will identify environmental issues, analyze solutions in the context of functional and economic needs, refine new methodologies for reducing environmental impacts, and develop implementation options.

Addr: Ralph Earle
Environmental Defense Fund
6 North Market Building
Fanueil Hall Marketplace
Boston, MA 02109
Tel: 617-723-2996
Fax: 617-723-2999
E-mail: ralph@ef.org

American Institute for Pollution Prevention (AIPP)

AIPP is an educational, not-for-profit organization that works with trade associations and professional societies to promote pollution prevention within industry and throughout society. Many of AIPP's initiatives involve EMS. AIPP's annual meeting includes updates on ISO 14000 and discussions regarding if and how companies are proceeding with implementation.

Addr: Julie Fero
American Institute for Pollution Prevention
1616 P Street NW
Suite 100
Washington, DC 20036
Tel: 202-797-6567
Fax: 202-797-6559
E-mail: cd001001@mindspring.com
URL: <http://es.inel.gov/aipp/>

Coalition for Environmentally Responsible Economies (CERES)

CERES promotes responsible corporate activity for a safe and sustainable future for our planet. The coalition engages environmental organizations, the investment community, and corporations in a dialogue about environmental performance, both to forge a new and meaningful dialogue with corporations about the protection of the planet and to establish a well-informed public that chooses where to

invest its capital based on environmental, not just economic, performance. CERES is promoting the creation of a widely-accepted mechanism for corporate self-governance that will maintain business practices consistent with the idea that economic vitality and environmental responsibility are compatible.

Addr: Randy Rice
CERES
711 Atlantic Avenue
Boston, MA 02111
Tel: 617-451-0927
Fax: 617-482-2028
E-mail: ceres@igc.apc.org
URL: <http://www.ceres.org>

Community Nutrition Institute (CNI)

Joint Policy Dialogue on Trade and the Environment. CNI is currently hosting a series of facilitated policy dialogues between the environmental and business communities in an effort to promote consensus-based trade and environmental policy. Dialogue participants include the U.S. Council for International Business, DuPont, National Association of Manufacturing, U.S. Chamber of Commerce, Chemical Manufacturing Association, and other concerned business organizations. Environmental nongovernmental organizations include the Sierra Club, National Wildlife Federation, World Wildlife Fund, Center for International Environmental Law, National Resources Defense Council, and others.

CNI's trade and environment team is currently researching and drafting a discussion document addressing ISO 14000 and the relevant trade and environment issues related to this topic. The paper will serve as a basis for a future dialogue workshop, and copies will be made available upon request to interested parties outside the dialogue group

Addr: Deborah Siefertt, Jake Caldwell, or

David Wirth

Community Nutrition Institute
910 17th Street, NW
Washington, DC 20006

Tel: 202-776-0595

Fax: 202-776-0599

E-mail: cnitrade@ige.apc.org

The Global Environmental Management Initiative (GEMI)

GEMI is committed to Environmental Health and Safety excellence throughout the business community. GEMI's 21 member companies represent a cross section of industry with over a million employees and combined annual revenues exceeding \$400 billion. Established in 1990, GEMI is a 501(c)(3) nonorganization. GEMI produced an ISO 14001 EMS self-assessment program in March 1996.

Addr: **Tammy Marshall**, Operations Manager
1090 Vermont Avenue
NW Third Floor
Washington, DC 20005

Tel: 202-296-7449

Fax: 202-296-7442

E-mail: gemi@worldweb.net

URL: <http://www.gemi.org>

The Good Neighbor Project for Sustainable Industries

This project helps to shape stakeholder participation disclosure, input, and participation by neighbors and workers by including these elements in ISO 14000 environmental management processes.

Addr: **Sanford Lewis**, Director
P.O. Box 79225
Waverly, MA 02179

Tel: 617-354-1030

Fax: 617-492-1635

E-mail: sanlewis@igc.apc.org

URL: <http://www.envirolink.org/orgs/gnp>

Green Seal Environmental Partners Program

The program provides Agreen@ buying assistance to businesses concerned about the environmental impacts of their purchases. Partners receive comprehensive, expert advice, including lists of products recommended on the basis of their environmental impact, product performance, and packaging. Members include large and small businesses, universities, government agencies and nonprofit organizations; participants number over 1000.

Addr: **Michael Shor**
Green Seal Environmental Partners Program
1730 Rhode Island Avenue, NW
Suite 1050
Washington, DC 20036-3101

Tel: 202-331-7337

Fax: 202-331-7533

E-mail: green Seal@aol.com

ANSI/GETF ISO 14000 Integrated Solutions (IIS)

The American National Standards Institute (ANSI) and the Global Environment & Technology Foundation (GETF) developed this program to serve as the primary disseminator and facilitator of ISO 14000 information in the United States.

IIS is composed of four services: training (currently being done through a national network of community colleges), ISO 14000 conferencing, publications, and an on-line information service, IIS ON-Line. Each service promotes awareness, competence, confidence,

and skills for ISO 14000 implementation in both public and private sectors.

Addr: Mary Clare Lynch
ANSI
11 West 42nd Street
New York, NY 10036
Tel: 212-642-4956
Fax: 212-598-0023
E-mail: mlynch@ansi.org
URL: <http://www.ansi.org>

Addr: Jacqui Keller
GETF
7010 Little River Turnpike, Suite
2\300
Annandale, VA 22302
Tel: 703-750-6401
Fax: 703-750-6506
URL: <http://www.iso14000.org>

GETF

GETF is a foundation committed to facilitating the cooperative integration of enterprise, technology, and the environment into sustainable systems in the United States and abroad. GETF facilitates strategic thinking, supports environmental policy development, builds consensus and knowledge sharing, and encourages partnership building and collaboration; GETF also provides training and education about ISO 14000 standards.

Addr: Steve Wassersug, President
GETF
7010 Little River Turnpike
Suite 300
Annandale, VA 22302
Tel: 703-750-6401
Fax: 703-750-6506
E-mail: steve.wassersug@gnet.org
URL: <http://www.iso14000.org>

Addr: Lynne Rasmussen, Director of Legal
Affairs, GETF
7010 Little River Turnpike, Suite 300

Annandale, VA 22302

Tel: 703-750-6401
Fax: 703-750-6506
E-mail: lynne.rasmussen@gnet.org
URL: <http://www.iso14000.org>

Green Mountain Institute for Environmental Democracy (GMIED)

GMIED provides assistance to regional, state, and local governments; comparative risk projects; and place-based initiatives in the development of environmental indicators and program measures. GMIED also serves as a clearinghouse for environmental indicator reports and activities and produces a bimonthly newsletter covering environmental management.

Addr: James R. Bernard
GMIED
104 East State Street
Montpelier, VT 05602
Tel: 802-229-6077
Fax: 802-229-6076
E-mail: jbernard@gmied.org

ISO 14000 Legal Issues Forum

The ISO 14000 Legal Issues Forum was established by the U.S. Technical Advisory Group in September 1995 to provide a vehicle of discussion of legal issues arising in the implementation of the ISO 14000 series of standards. Under the co-chairmanship of David J. Freeman of Battle Fowler LLP and Ira R. Feldman of GT Strategies and Solutions, the Forum has grown to a membership of over 200 individuals and organizations. Its members include both governmental officials and representatives of nonprofit groups.

The forum meets bimonthly, with each meeting devoted to addressing a specific topic of interest to its membership. A participation fee of \$75

entitles members to attend bimonthly meetings and to receive detailed reports of the proceedings.

Addr: David Freeman
Battle Fowler LLP
75 East 55th Street
New York, NY 10022
Tel: 212-856-7126
Fax: 212-856-7820
E-mail: dfreeman@battlefowler.com

Addr: Ira Feldman
GT Strategies and Solutions
1300 Connecticut Avenue
Washington, DC 20036
Tel: 202-530-9770
Fax: 202-530-9772
E-mail: I@erols.com

Management Institute for Environment and Business (MEB)

Industrial Products, Inc.: Measuring Environmental Performance (Case Study). In 1993, Industrial Products, Inc., was a highly diversified privately-held manufacturing company with two business objectives: increase return on equity and decrease environmental impact. This case examines management's efforts to design and implement a management system for measuring the impact of its operations on the environment. The student gains an understanding of the system, and is asked to evaluate its effectiveness. The industrial products management system illuminates the ISO 14000 series standards. A teaching note is available.

Addr: Rebekah Paulson
Management Institute for
Environment and Business
1709 New York Avenue, NW
Washington, DC 20006

Tel: 202-434-1980
Fax: 202-737-1510
E-mail: briann@wri.org
URL: <http://www.wri.org/wri/meb>

ISO 14000 Workgroup for the National P2 Roundtable

The first official meeting of this group was held in November 1996 as part of the National Pollution Prevention (P2) Roundtable's regular workgroup meetings. Some example issues addressed were: How can P2 mesh with the standard? Will P2 be included in the auditor training and if so, how? What is the role of technical assistance personnel? Can small- and medium-sized manufacturers benefit from ISO 14000 and what are some of their implementation issues? Will the standard lead to source reduction? This workgroup will generate and maintain an ISO 14000 e-mail list.

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P.O. Box 29569
Raleigh, NC 27626
Tel: 919-715-6507
Fax: 919-715-6794
E-mail: ravila_gupta@owr.chnr.state.nc.us

Addr: Krista Johnsen Leuteritz
NIST/MEP
Building 301, Room C-100
Gaithersburg, MD 20899
Tel: 301-975-5104
Fax: 301-926-3787
E-mail: kristin.johnsen@nist.gov
URL: <http://www.mep.nist.gov/>

New England Environmental Network

Nothing To Waste Initiative (NTW). The NTW Initiative is a pilot environmental justice and pollution prevention program designed to

provide and link necessary economic and environmental resources to small businesses in low income communities of color. NTW infuses pollution prevention tools and continuous improvement techniques into peer lending groups of four to ten small business owners who are participating in the business education and loan program of Working Capital, a nonprofit community development finance agency. With initial funding from EPA, the NTW pilot has functioned as a unique collaboration between local community development corporations (Grove Hall CDC in Roxbury, MA, and Green Island CDC in Worcester, MA); Working Capital, Cambridge Environmental, Inc.; and the New England Environmental Network at Tufts University.

Addr: Marcy Goldstein-Gelb,
Massachusetts Director, Working
Capital
New England Environmental Network
99 Bishop Allen Drive
Cambridge, MA 02139
Tel: 617-576-8620
Fax: 617-576-8623
E-mail: wcapmgelb@aol.com

Addr: Rona Julien
U.S. EPA Region 1
Tel: 617-565-9454

The Pacific Institute

The Pacific Institute for Studies in Development, Environment and Security is an independent, non-profit center conducting research and policy analysis in the areas of environment, sustainable development, and international security. The Institute focuses on the interrelatedness of many of the problems facing our planet and seeks comprehensive solutions to these problems.

Addr: Peter Gleick, President
Pacific Institute
1204 Preservation Park Way
Oakland, CA 94612

E-mail: pistaff@pacinst.org

The Rainforest Alliance

The Smart Wood Program. Initiated in 1989, the program initially focused on tropical forests. Today, Smart Wood works in all forest types worldwide. The purpose of Smart Wood is to provide independent, objective evaluation of forest management practices, forest products, timber sources, and companies, enabling the public to identify products and practices that do not destroy forests. Through certification and use of the Smart Wood label the program provides a commercial incentive for forest managers to adopt sustainable forestry practices. Smart Wood certifies forest products that come from Asustainable@ or Awell managed@ forests (Asources@); Smart Wood also certifies companies that process, manufacture, or sell products made from certified wood, through Achain of custody@ certification.

Addr: Richard Donovan, Director
65 Bleecker Street
New York, NY 10012-2420
Tel: 212-677-1900
Fax: 212-677-2187
E-mail: smartwood@ra.org
URL: <http://www.rainforest-alliance.org>

The Sierra Club

The Sierra Club is tracking the application of ISO 14000 to ensure that it is applied in a manner that will result in increased environmental protection and it reflects accurate information about how ISO 14000-rated firms are promoting a high standard of environmental performance.

Addr: Dan Seligman, Trade and
Environment Director
Sierra Club
408 C Street NW
Washington, DC 20016
Tel: 202-675-2387

Fax: 202-547-6009
E-mail: dan.seligman@sierraclub.org
URL: <http://www.sierraclub.org>

Addr: **Jerry Speir, Director**
Tulane Institute for Environmental
Law and Policy
Tulane Law School
New Orleans, LA 70118-5670

Tel: 504-862-8829

Fax: 504-862-8857

E-mail: jspeir@law.tulane.edu

Addr: **John Audley**
2247 Laeb
Political Science Department
Purdue University
West Lafayette, IN 47907

Tel: 317-494-7599

E-mail: audley@polsci.purdue.edu

ACADEMIC

Brown University

Brown Is Green (BIG) Program. BIG is an environmental education and advocacy program established to involve undergraduates in the research and analysis of environmental problems related to university operations and provide a model for active learning that can be replicated nationally. The students involved in this program develop skills in incorporating environmentally benign technology and methods into daily operations. They also devise and test methods for educating individuals within an organization on the environmental effects of their behavior.

Addr: **Kurt Teichert, Environmental Coordinator**
Brown University
Box 1943
Providence, RI 02912-1943

Tel: 401-863-7837
Fax: 401-863-3503
E-mail: kurt_teichert@brown.edu
URL: http://www.brown.edu/departments/brown_is_green

Georgia Institute of Technology, Economic Development Institute (EDI)

EDI provides ISO 14000 information, training, and implementation assistance through EDI's Center for International Standards and Quality (CISQ). Companies can enroll in a customized implementation program that will help them successfully prepare for ISO 14000 registration, participate in the ISO 14000 discussion group (a forum of business representatives who meet periodically to share information and experiences related to ISO 14000), and access current ISO 14000 information through CISQ's Standards Information Service.

Addr: **Donna M. Ennis**
Georgia Tech/CISQ/EDI
151 6th Street, Room 143
Atlanta, GA 30332-0640
Tel: 404-894-0968
Fax: 404-894-1192
E-mail: cisq.mail@edi.gatech.edu
URL: <http://www.edi.gatech.edu>

Montana State University Extension Service

Montana Pollution Prevention Program. This program provides pollution prevention technical assistance to small businesses (automotive, wood working, printers, hotels/motels, construction, dry-cleaning), schools, Native American tribes, local government, and agricultural operations.

Addr: **Dr. Michael P. Vogel**

Montana State University Extension
Service

109 Taylor Hall
Bozeman, MT 59717

Tel: 406-994-3451

Fax: 406-994-5417

E-mail: acxmu@trex.oscs.montana.edu

URL: <http://www.montana.edu/wated>

University of Maryland

Environmental Finance Center (EFC). Part of the Coastal and Environmental Policy Program at the University of Maryland, EFC was created to train, provide assistance, and act in an advisory capacity to state and local governments on issues related to environmental finance. Among other activities, EFC advises local officials in forums for frank discussions between local officials and finance experts about financing difficulties experienced by communities in meeting their environmental demands.

Addr: Elizabeth Hickey
EFC
University of Maryland
Coastal and Environmental Policy
Program
0112 Skinner Hall
College Park, MD 20742

Tel: 301-405-6383

Fax: 301-314-9581

E-mail: hickey@umbi.umd.edu

URL: <http://www.mdsg.umd.edu:80/mdsg/envifin/index.html>

Salt Lake Community College

The Environmental Training Center. The Environmental Training Center provides noncredit workshops in environmental health and safety subjects. This includes 1- and 2-day workshops on the ISO 14000 standard.

Addr: Neal K. Ostler, Center Coordinator
Millcreek Center

1521 East 3900 South
Salt Lake City, UT 84124

Tel: 801-957-4942

Fax: 801-957-3848

E-mail: ostlerne@slcc.edu

URL: <http://www.slcc.edu/cce/hazwop.htm>

SUNY Buffalo

The Science and Engineering Library at SUNY Buffalo, in conjunction with other university libraries, is compiling a list of print and electronic resources related to the topic of Environment and Business, including resources for ISO 14000, Clean Products and Design, and Life Cycle Assessment. The resources are maintained on the Science and Engineering Library Web site under Internet Resources by Subject: Environment. Other fee-based information services are also available from the Science and Engineering Library upon inquiry.

Addr: Frederick W. Stoss, M.S., M.L.S.,
Associate Librarian
Science and Engineering Library
Capen Hall, Room 228-B
SUNY Buffalo

Buffalo, NY 14260-2200

Tel: 716-645-2946 ext. 224

Fax: 716-645-3710

E-mail: fstoss@acsu.buffalo.edu

URL: <http://wings.buffalo.edu/libraries/units/sel/>

Tulane Institute for Environmental Law and Policy

ISO 14000 From a Public Interest Perspective.

This initiative attempts to assess and respond to developments in ISO 14000 implementation from a nongovernmental and nonindustry perspective.

Addr: Jerry Speir, Director
Tulane Institute for Environmental
and Policy
Tulane Law School

New Orleans, LA 70118-5670
Tel: 504-862-8829
Fax: 504-862-8857
E-mail: jspeir@law.tulane.edu

University of Wisconsin-Stout

Economic Development Administration University Center (EDA-UC). The University of Wisconsin-Stout's EDA-UC provides service and assistance in management system education, training, and outreach to regional businesses and industry on the implementation and operation of systems based on international standards.

Addr: **Dr. Wallace Carlson**, Professor
Industrial Management
University of Wisconsin-Stout
Menomonie, WI 54751
Tel: 715-232-5162
Fax: 715-232-1105
E-mail: carlsonw@uwstout.edu

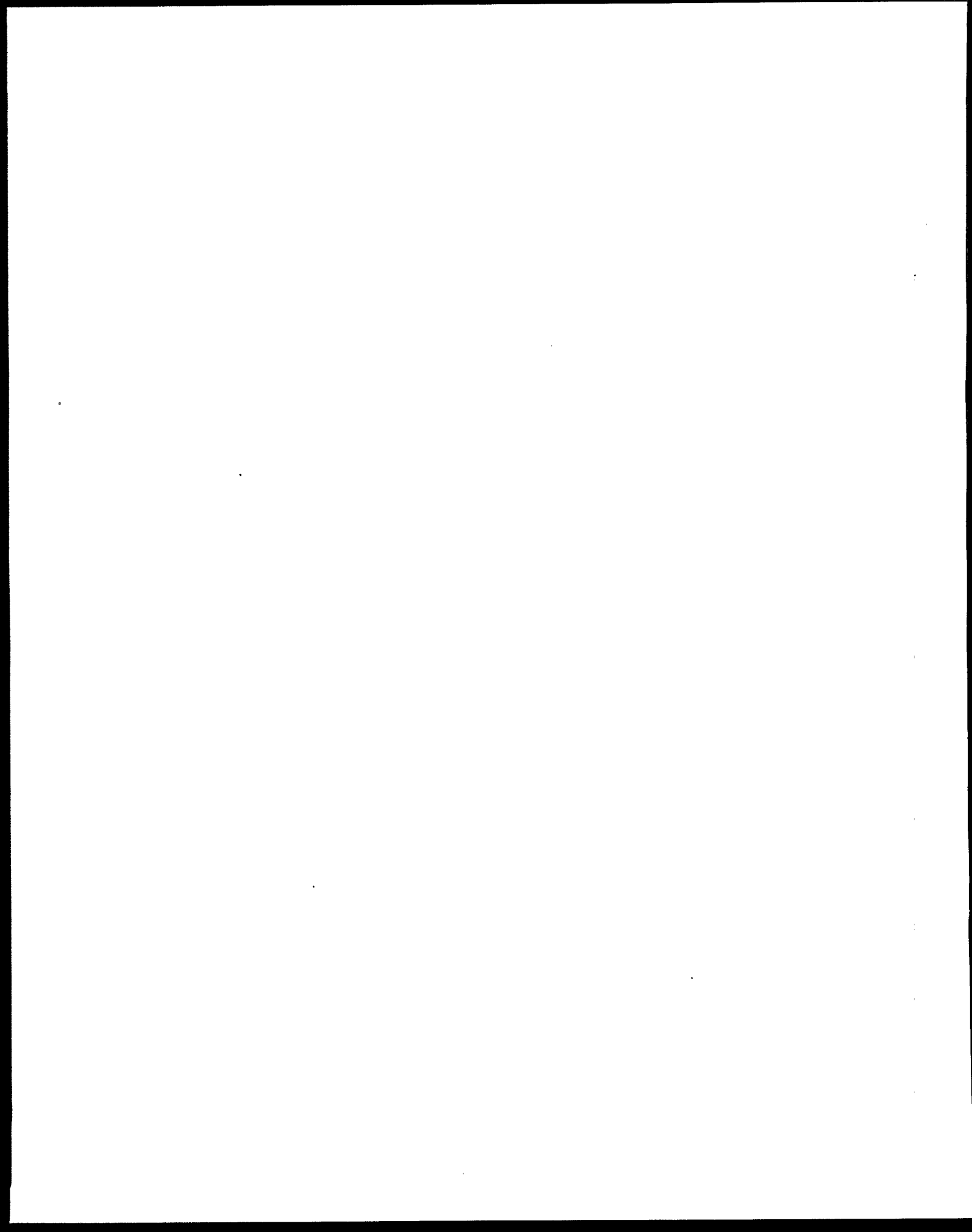
Addr: **Nancy Jennejohn**,
EDA-UC Program Manager
University of Wisconsin-Stout
Menomonie, WI 54751
Tel: 715-232-5023
Fax: 715-232-1985
E-mail: jennejohn@uwstout.edu

Vanderbilt Center for Environmental Management Studies (VCEMS)

VCEMS was formed to promote and develop partnerships between industry, government, and academia to explore new environmental management practices and opportunities. VCEMS' most recent initiatives include incorporation of ISO 14000 principles into the established environmental management framework and to remove the Agreen wall@

barriers to sound environmental management programs.

Addr: **Paige Macdonald**, Program Director
VCEMS, Vanderbilt University
1207 18th Avenue South
Nashville, TN 37212
Tel: 615-322-8004
Fax: 615-343-7408
E-mail: macdonald@uansv5.vanderbilt.edu
URL: <http://www.vanderbilt.edu/vcems>

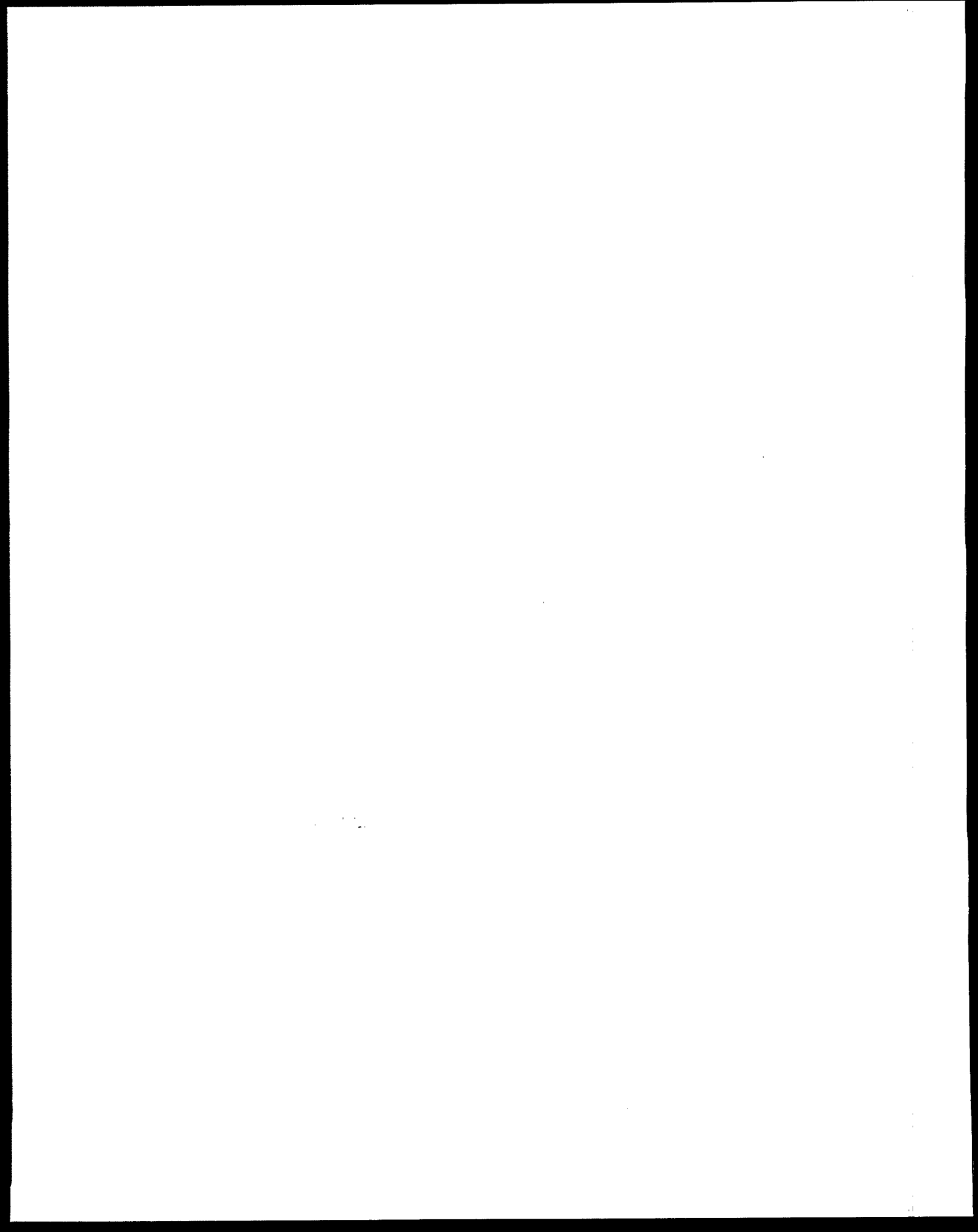


6 INTERNATIONAL INITIATIVES

The international listings in this chapter include multilateral organizations with initiatives that extend across national boundaries and a sampling of national initiatives based in other countries that may be useful both as information resources as well as models for programs in the United States.

1. Multilateral Organizations

2. Alphabetical Listings by Country



MULTILATERAL ORGANIZATIONS

Environmental Management Secretariat for Latin America and the Caribbean (LAC)

The purpose of the Environmental Management Secretariat in the LAC region is to facilitate the improvement of environmental management through the application of three interrelated instruments: research, horizontal cooperation, and information systems (largely Internet based) to support decisions by those engaged in policy formulation and implementation and in activities based on services or raw materials derived from renewable resources.

The secretariat is also developing a focused research program through competitive small research grants to address the key environmental management issues of the region.

Addr: **Alexis Ferrand**
Environmental Management
Secretariat
c/o CIID/IDRC
Casilla de Correo 6379
Montevideo, Uruguay
Tel: +598-2-922031/4 - 922037/44
Fax: +598-2-920223
E-mail: aferrand@idrc.ca
URL: <http://www.chasque.apc.org/sema>

Commission for Environmental Cooperation (CEC)

CEC was created to address regional environmental concerns, help prevent potential trade and environmental conflicts, and promote the effective enforcement of environmental laws.

Current related activities of the CEC include a study of North American experiences with voluntary compliance, including ISO 14000 and an examination of the interface between ISO 14000 and enforcement and compliance policies and programs.

Addr: **Linda F. Duncan**, Head
Law & Enforcement Cooperation
Program
CEC
393 Rue St. Jacques Bureau 200
Montreal, Quebec, H2Y 1N9
Tel: 514-350-4334
Fax: 514-350-4314
E-mail: lduncan@ccemtl.org
URL: <http://www.cec.org>

Organisation for Economic Cooperation and Development (OECD)

Sustainable Product Policies and Life Cycle Management. The objective of the project is to monitor initiatives and policies that favor the diffusion of life cycle approaches among economic factors. This entails following the work that ISO and other organizations are carrying out, and examining implications for the transfer of information in the marketplace (e.g., through ecolabelling initiatives and life cycle assessments), product performance standards, public purchasing of environmentally preferable goods and services, and extended producer responsibility.

Addr: **Carlo Pessa**
OECD
2 Rue Andre Pascal
75775 Paris
France
Tel: +33-1-45-24-16-82
Fax: +33-1-45-24-78-76
E-mail: Carlo.PESSO@oecd.org
URL: <http://www.oecd.org/env/divppc.htm>

United Nations Conference on Trade and Development (UNCTAD)

Training Program for Officials Interested in ISO in Developing Countries. Many businesses operating in or trading with developing countries are not fully aware of the developments in ISO 14000. A training guide is being developed by a United Nations (UN) agency in Geneva, Switzerland (the UN Conference on Trade and Development), to provide information. Benchmark Environmental Consulting served as the consultant for the research and writing.

Addr: Dr. John Cuddy, Coordinator
Sustainable Development Program
UNCTAD
Rm. E9077
Palais des Nations
CH-1211 Geneva 10
Switzerland

Fax: +4122-907-0045

Addr: Dr. Harris Gleckman
Benchmark Environmental Consulting
470 Forest Ave, Suite 302
Portland, ME 04101

Tel: 207-775-9078

Fax: 207-772-3539

E-mail: benchmark@interramp.com

URL: www.greenchannel.com and
http://194.177.160.204:80/standards
/iso/14001/

United Nations Environmental Program (UNEP)

UNEP Metadata Directory. The UNEP Metadata Directory serves as a card catalogue of environmental information. It contains card entries (or metadata descriptions) of institutes and datasets and allows users to search for environmental information by institute name or dataset (title), contact person (author), theme, keyword, and location (subject), as well as other criteria.

Addr: James McKenna, Program Officer
UNEP

P.O. Box 3052

Nairobi, Kenya

Tel: +254-2-623899

Fax: +254-2-624315

E-mail: mckennaj@unep.no

URL: http://www.grid.unep.no

United Nations Industrial Development Organization (UNIDO)

UNIDO is conducting several studies to make recommendations for government policies and strategies related to productivity, quality, and environment in the Economic and Social Commission for the LAC region. The studies pay particular attention to the impact of ISO 14000 standards on industrial competitiveness and policy recommendation.

Addr: Mr. Hessel Schuurman,
ECLAC/UNIDO

Associate Expert

P.O. Box 179-D

Santiago, Chile

Tel: +56 2-210-2417

Fax: +56 2-208-0252

E-mail: hschuurm@eclac.cl

US-AID

EMS Development for Industry - Electric Power Sector. The Central Maine Power Company and the Natsionalna Elektrieska Kompania of Bulgaria are working on a U.S. AID-funded effort to develop EMS for major power plants in Bulgaria and for the central electric utility system. Bulgaria has adopted environmental standards similar to those of western Europe and the United States, however, both the plant equipment and the management systems are dated in terms of being able to meet these standards. This initiative will help the management side of environmental businesses. One major power plant was selected for system development; at the discretion of the Natsionalna

Elektricheska Kompania, the EMS techniques will be transferred to the rest of the system.

Addr: Dr. Robert Ichord, Jr.
U.S. AID
320 21st Street NW
Washington, DC 20523
Tel: 202-647-6962
Fax: 202-647-8274

Addr: Hristo Shwabsky
Natsionalna Elektricheska Kompania
Sofia, Bulgaria
Tel: 359-2 980-1968
Fax: 359-2-875826
E-mail: nek.s.msp@mcr1.poptel.org.uk

Addr: James H. Wazlaw
Central Maine Power International
One Grandview Place
Winthrop, ME 04364
Tel: 207-626-9749
Fax: 207-626-9597

(Cross-listed with State Initiatives, chapter 4)

The United States Environmental Training Institute (USETI)

USETI is working in conjunction with Environmental Pollution Control and Sanitation Technology Company of Sao Paulo State (CETESB) coordinating a Green Procurement Policy project and P2/ISO 14000 courses.

Addr: Joel Riciputi
USETI
100 Thomas Jefferson Street, NW
Suite 106
Washington, DC 20007
Tel: 202-338-3400
Fax: 202-333-4782

Addr: Julia Alves
Rua Murupi, 195
Sao Paulo, Capital 05467-040
Brazil
Tel: +55-11-3030-6491 or +55-1-3030-6490
Fax: +55-11-3030-6401
E-mail: juliaa@cetesb.br

World Bank

Informal Working Group on ISO 14000. This group is addressing the possible implications on environment and trade for the countries. No documents have yet been published.

Addr: David Hanrahan
Environment Department (Room S3069)
World Bank
1818 H Street NW
Washington, DC 20433
Tel: 202-458-5686
Fax: 202-477-0968
E-mail: dhanrahan@worldbank.org

COUNTRY INITIATIVES

Austria

EU Environmental Management and Audit Scheme (EMAS). The objective of the scheme is to promote continual improvements in the environmental performance of industrial activities by 1) establishing and implementing environmental policies, programs, and management systems; 2) evaluating the performance of such elements; and 3) establishing public information vehicles.

Addr: Johannes Mayer, Director
Dept. Information-Documentation-
Library
Federal Environment Agency
Spittelauer Laende 5, A

1090 Vienna, Austria
Tel: +43-1-31304-3240
Fax: +43-1-31304-5400
E-mail: mayer@uba.ubavie.gv.at
URL: <http://www.ubavie.gv.at>

Institute for Ecological Research in Economics. The institute conducts research in the field of environmental management, ecobalances, environmental accounting, pollution, and ecodesign.

Addr: Dr. Christine Jasch
Institut für Ökologische
Wirtschaftsforschung
Rechte Wienzeile 19/5, A-1043 Wien
Austria
Tel: +0043-1-587-21-89
Fax: +0043-1-587-09-71
E-mail: ioew@magnet.at

Bolivia

Sustainable Development Networking Programme (SDNP). SDNP comprises a network of institutions related to sustainable development and environment issues through e-mail connectivity and Internet facilities. The institutions are from the government, private, academic, and international cooperation sectors.

Addr: Juan Pablo Arce, National Coordinator
Sustainable Development and
Environment Ministry
RDS/UNDP
P.O. Box 12814
La Paz, Bolivia
Tel: +591-2-317320
Fax: +591-2-317320
E-mail: sdnp@coord.rds.org.bo
URL: <http://coord.rds.org.bo>

Canada

The Health Sciences Centre (HSC). HSC is currently implementing an ISO 14001 Pilot Project in a 900 bed tertiary care teaching hospital.

HSC is participating in the Canadian Standards Association's (CSA) Pilot Project to implement an EMS in conformance with the draft ISO 14000 series of environmental standards. HSC already has several components of the system in place: 1) an environmental policy and senior management commitment to the policy, 2) an initial environmental review of issues, and 3) a performance reporting process.

During the next 12 months, the complete specifications for all processes in the EMS will be drafted in conformance with the ISO 14001 standard.

Addr: John Reimer, P.E.
Health Sciences Centre
Environmental Protection Department
Room MH 216
59 Pearl Street
Winnipeg, Manitoba
R3E 3L7 Canada
Tel: 204-787-4792
Fax: 204-787-4854
E-mail: j.reimer@awnet.com
URL: <http://www/hsc.mb.ca> (under construction)

Canadian Departments of Environment and Industries' National Environmental Training Initiative. This initiative provides training materials and other source documents on the implementation of ISO 14000 voluntary environmental management standards to small and medium sized businesses.

Addr: Dennis Landry
13th Floor
351 St. Joseph Blvd.
Hull, Quebec K1A 0H3
Tel: 819-994-7977
Fax: 819-953-7970

EMS Accreditation Program. The program is governed by guidelines contained in Standards Council of Canada (SCC) publications entitled "Criteria and Procedures for Accreditation of Organizations Registering Environmental

Management Systems" (CAN-P-14), "Criteria and Procedures for Accreditation of Environmental Auditors Certification Organizations" (CAN-P-1412), and, in the near future, "Criteria and Procedures for the Accreditation of Environmental Auditor Training Courses and Providers" (CAN-P-1413). The SCC is a federal crown corporation and a nonprofit organization. All components of this program operate on a full cost-recovery basis.

An advisory committee on EMS, made up of experts in the field, oversees the accreditation program and provides advice to SCC on matters pertaining to the environment. The SCC's deputy director of standardization is currently responsible for the day-to-day operation of the program; the manager of conformity assessment will assume this responsibility in the summer of 1997.

Registrars submit a written application to the SCC for accreditation, describing their organization and resources and including a fee as outlined in a published fee schedule. The environmental auditor certifiers submit a similar application as will the environmental auditor course providers.

Addr: Don Wilson, P.E.
45 O'Connor Street
Ottawa, ON K1P 6N7
Canada
Tel: 613-238-3222, ext. 140
Fax: 613-995-4564
E-mail: dwilson@scc.ca
URL: <http://www.scc.ca>

Kyrgyzstan

Ecologist Club. The club manages independent monitoring of Human Ecology in Kyrgyzstan and neighboring regions.

Addr: Khodjamberdiev Igor, President
Ecologist Club
Khodjamberdiev, P.B.1451

Bishkek, Kyrgyzstan, 720040

Tel: +3312-221041

Fax: +3312-288362

E-mail:

igorho@nlpub.freenet.bishkek.su

Romania

Advanced Interactive Training Course on EMS. This course applies the principles of the British Standard 7750 (BS 7750) and the European Eco Management and Audit Scheme (EMAS) in Romania.

The course is delivered over 3 days with the participants implementing the first 2 stages of an EMS, gaining commitment and policy formulation and performing the initial review during the month following the course. After a month, they participate in a 2-day workshop where they present achievements, receive an attendance diploma, and receive training in management for change.

Addr: Bogdan O. Paranici
Str. Academiei 27, et. 2, Apartment 5
70108, Sector 1
Bucharest, Romania
Tel: +40-1-312-66-39 or 615-02-32
Fax: +40-1-312-42-63
E-mail: oparanici@pcnet.pcnet.ro

Spain

Program of communication and interpretation in protected natural areas. Make available information and general services for visits to natural areas, services of interpretation and guided itineraries, formation and coordination of a volunteer program, communication to the local population and promotion of local participation

Addr: Mariano Soriano Urban, Ph. D
Instituto de Ciencias Sociales y
Ambientales
Gral. Martin Carrera
Ed. Dunia II, B-A

E-30011-Murcia

Spain

Tel: +34-908-36-19-37 or +34-968-26-97-91

Fax: +34-968-26-97-91

E-mail: murban@ctv.es

URL: <http://ctv.es/USERS/murban>

Sweden

Chalmers University of Technology, Managing for Environmental Opportunities. Chalmers University of Technology offers this program through its executive education organization, Chalmers Advanced Management programs (CHAMPS).

The focus is business-oriented and covers issues like scenario-based strategy development, transformation of the enterprise to gain environmental competitive advantage, development and implementation of EMS such as ISO 14000, and the EMAS. The program brings together a faculty of internationally renowned lecturers, NGOs, and industry cases with a mixed group of participants. The program is divided into two modules that is carried through in Sweden and the Netherlands.

Addr: Peter Lindwall
CHAMPS
Chalmers Teknikpark
S-412 88 Gothenburg
Sweden

Tel: +46 31-772-43-22

Fax: +46 31-772-41-71

E-mail:

peter.lindwall@champs.chalmers.se

URL: <http://www.champs.chalmers.se/>

Switzerland

Quality Management Systems / Environmental Management Systems (QMS / EMS). This project introduces EMS in accordance with ISO 14001 to companies who already are in accordance with ISO 9000 to ensure the most efficient changeover process. The project commenced January 1, 1995, and is working

closely with the primary certifier for EMS accreditation for ISO standards in Switzerland.

Addr: Reto Felix

University of St. Gall

Institute for Management of Technology
(ITEM-HSG)

Unterstrasse 22

CH-9000 St. Gall

Switzerland

Tel: +41-71-228-24-14

Fax: +41-71-228-24-20

E-mail: reto.felix@item.unisg.ch

URL: <http://www.unisg.ch/~item/PROJECT/QM/qmsems.html>

United Kingdom

Centre for Environmental Technology. The Centre is currently running three EMS oriented projects in the United Kingdom (UK) and the European Union (EU): 1) a pilot project to investigate the application of a standard methodology to implement the EU Eco-management and audit scheme (EMAS) in selected SMEs across the EU; 2) a UK study into environmental threats and opportunities facing SMEs and their associated management strategies, and 3) a pilot study investigating the barriers and opportunities facing enterprises implementing EMAS and other EMS such as the British standard BS 7750 and ISO 14001.

Addr: Ruth Hillary

Centre for Environmental Technology
Imperial College of Science,

Technology, and Medicine

48 Prince's Gardens

London SW7 2PE England

Tel: +44-171-589-5111

Fax: +44-171-581-0245

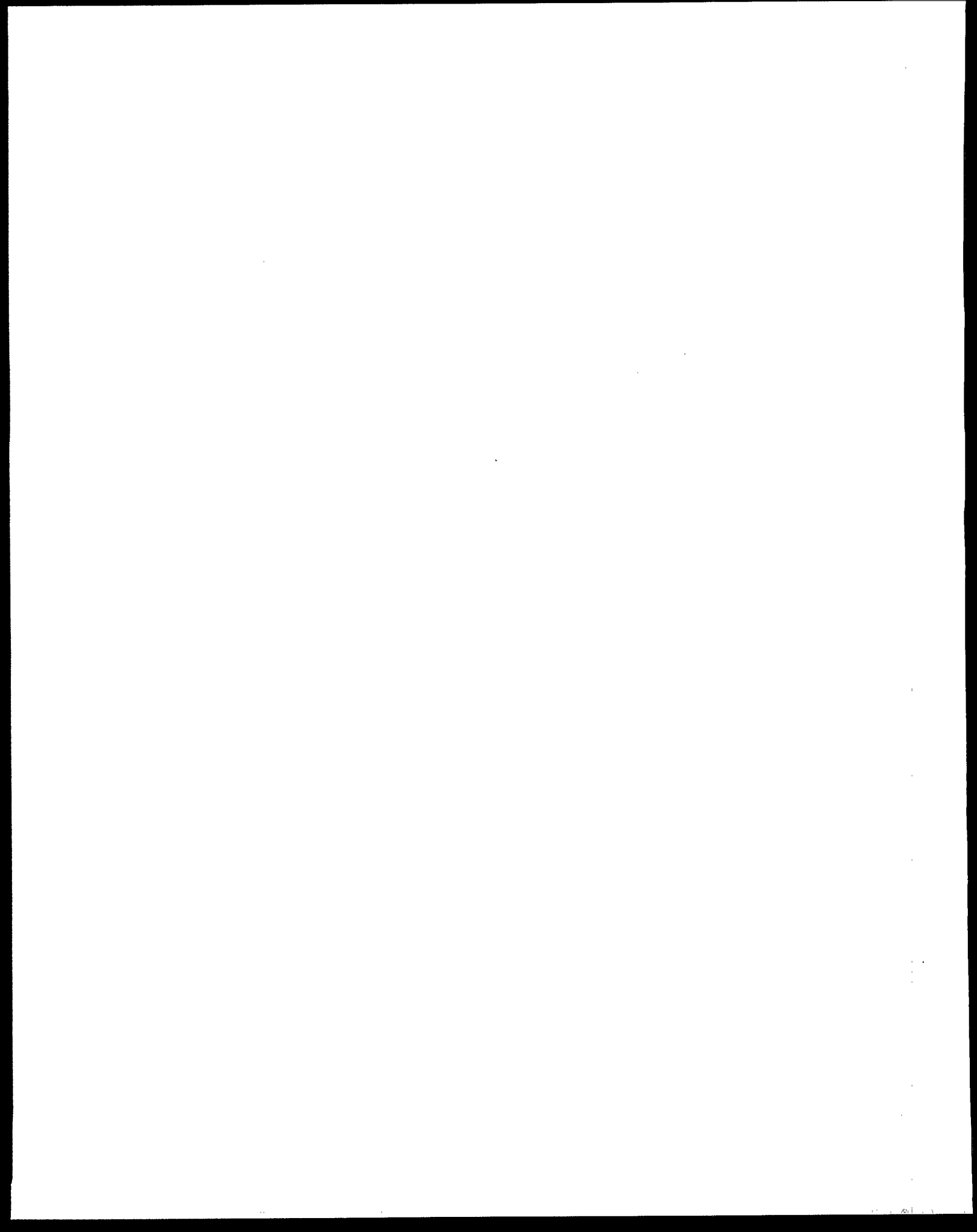
E-mail: r.hillary@ic.ac.uk

7 RESOURCES

This chapter presents listings of ISO 14000-related *resources* rather than *initiatives*. These resources may be useful sources of information to organizations exploring ISO 14000, and several categories of resources are included. Each entry only briefly describes the resource; contact information is provided for use in obtaining more details.

The entries included in this section are not endorsed or approved in any way by EPA. All submitted entries that were applicable for inclusion in the Directory have been listed. Because the purpose of this Directory is to provide information on government activities concerning ISO 14000 and/or Environmental Management Systems (EMS), it is beyond the scope of the Directory to include a comprehensive listing of all the private sector organizations and initiatives also involved in ISO 14000 and/or EMS. Every effort has been made to ensure the information in each entry is correct.

- 1. U.S. national Standards**
- 2. International Standards**
- 3. Accreditation**
- 4. Training**
- 5. Clearinghouses**
- 6. Publications**
- 7. Internet Resources**



U.S. NATIONAL STANDARDS

The American National Standards Institute (ANSI)

ANSI is the single, private sector certifier of U.S. national standards, and is the sole U.S. member body to the International Organization for Standardization (ISO). ANSI does not develop standards, rather ANSI is responsible for providing U.S. input, through Technical Advisory Groups (TAGs), to international standards development committees in ISO. Contact: **Jane Schweiker**, Director Public Policy and Government Relations, ANSI, 7315 Wisconsin Ave., Suite 250-E Bethesda, MD 20814. Tel: 301-469-3363. E-mail: jschweik@ansi.org.

Three U.S. standards organizations, which are members of ANSI, cooperate in the administration of the U.S. TAG for ISO 14000 standards. They are:

American Society for Testing & Materials Initiatives (ASTM)

ASTM is the primary administrator for the entire U.S. TAG to ISO TC207. **Kathy Morgan**, ASTM, 100 Bar Harbor Dr., West Conshohocken, PA 19428. Tel: 610-832-9721. Fax: 610-832-9666. E-mail: kmorgan@local.astm.org. URL: <http://www.astm.org>.

American Society for Quality Control (ASQC)

611 East Wisconsin Ave., P.O. Box 3005, Milwaukee, WI 53201. Tel: 800-248-1946. Fax: 414-272-1734.

NSF International

NSF International is an authorized source for the ISO 14000 standards. **Anita M. Cooney**, NSF International, 2100 Commonwealth Blvd., Ann Arbor MI 48105. Tel: 313-332-7333. Fax: 313-669-0196.

Information on these and other U.S. standards-setting bodies is provided through NIST (see page 3-1) or ANSI.

INTERNATIONAL STANDARDS

Both the World Trade Organization (WTO) and the North American Free Trade Agreement (NAFTA) recognize the national standards-setting bodies that are members of ISO. Information on TC207 Member Bodies and the countries they represent is available via the ISO home page: www.iso.org.

ACCREDITATION

ANSI-Registrar Accreditation Board (RAB)

National Accreditation Program (NAP) for ISO 14000 Environmental Management Standards.

ANSI-RAB conducts the U.S. national accreditation program that accredits registrars and training course

providers. **Rick James**, ANSI-RAB, 7315 Wisconsin Avenue, Suite 250-E, Bethesda, MD 20814. Tel: 301-469-3360. Fax: 301-469-3361.

TRAINING

ISO 14000 training courses are offered by a wide variety of organizations and companies within the private sector. Various federal and state agencies, universities, and other organizations may also offer in-house training courses. Information about these courses may be obtained by contacting them directly. Training course information within EPA may be obtained by contacting **Eric Wilkinson**, Voluntary Standards Network, U.S. Environmental Protection Agency (7409), 401 M St., SW, Washington, DC 20460. Tel: 202-260-3575. Fax: 202-260-0178. E-mail: wilkinson.eric@epamail.epa.gov.

CLEARINGHOUSES

EPA's Pollution Prevention Information Clearinghouse (PPIC)

PPIC disseminates information on the U.S. EPA's involvement with ISO 14000 via the Internet and EPA and Pollution Prevention Division home pages. **Susan Westerburg**, US. EPA., 401 M St., SW (MC 7407), Washington, DC 20460. Tel: 202-260-1758. Fax: 202-260-4659. E-mail: ppic@epamail.epa.gov.

World Data Center A (WDC-A) for Human Interactions in the Environment

Data resources available include collections of international environmental agreements, integrated assessment models of global climatic change, as well as the distributed international resources of CIESIN's Information Cooperative. **Dr. Roberta Balstad Miller**, Director, CIESIN, 2250 Pierce Road, University Center, MI 48710-0001. Tel: 517-797-2727. Fax: 517-797-2622. E-mail: ciesin.info@ciesin.org URL: <http://www.ciesin.org>

PUBLICATIONS

The ISO 14000 series of standards are copyrighted and can be obtained by contacting any of the following organizations: **ANSI**, 7315 Wisconsin Ave., Suite 250-E Bethesda, MD 20814. Tel: 301-469-3363. **ASTM**, 100 Bar Harbor Dr., West Conshohocken, PA 19428. Tel: 610-832-9721. Fax: 610-832-9666. **ASQC**, 611 East Wisconsin Ave., P.O. Box 3005, Milwaukee, WI 53201. Tel: 800-248-1946. Fax: 414-272-1734. **NSF International**, 2100 Commonwealth Blvd., Ann Arbor MI 48105. Tel: 313-332-7333. Fax: 313-669-0196.

INTERNET RESOURCES

Mailing Lists

#ecdm

The Environmentally Conscious Design and Manufacturing mailing list is as a forum for discussing issues regarding designs and manufacturing processes for products (including buildings) from an environmentally friendly viewpoint. Methods for analyzing these products are also discussed. Post messages to ecdm@pdomain.uwindsor.ca. The listserver address is: listserv@pdomain.uwindsor.ca. URL: <http://ie.uwindsor.ca/ecdmlist/welcome.html>.

#govpub

This list promotes the dissemination of local and state government information online to exchange ideas and information related to their efforts. Both the technical and policy issues of government information on the Internet are addressed. Post messages to: govpub@listserv.nodak.edu. The listserver address is: listserv@listserv.nodak.edu.

#iso14000

This unmoderated list is designed for the discussion of the ISO 14000 certification guidelines for environmental and related industries. Post messages to iso14000@quality.org. Listserver at majordomo@quality.org.

#quest

The QUEST list (Quality, Environment, Safety in Management).

Post messages to quest@listserv.nodak.edu. Listserver at listserv@listserv.nodak.edu.

#regref-l

This list (Regulatory Reform List) is a moderated discussion group that is intended to foster an interdisciplinary discussion about the reform of regulation. No one accepted definition of regulation exists for the purposes of this discussion group, the term "regulation" is used broadly to include the full range of legal instruments by which governing institutions, at all levels of government, impose obligations or constraints on private sector behavior. Post messages to regref-l@cyberus.ca. Listserver at majordomo@cyberus.ca. URL: <http://www.cyberus.ca>.

#tenep

The Electronic Network of Environmental Professionals (TENEP) moderated list. Post messages to tenep@envision.net.

ISO Websites

International Organization for Standardization

Official ISO Online site. ISO information including Your guide to ISO Online, Introduction to ISO, ISO structure, ISO members worldwide, ISO technical committees, ISO meeting calendar, ISO Catalogue; What's new at ISO?, and Other Web servers providing standards information. For specific questions and comments on this WWW server: webmaster@isocs.iso.ch. For general information and questions on ISO: CENTRAL SECRETARIAT ADDRESS 1, rue de Varembe, Case postale 56, CH-1211 Genève 20, Switzerland. Tel: + 41 22 749 01 11. Fax: + 41 22 733 34 30. E-mail: central@isocs.iso.ch. URL: <http://www.iso.ch>.

International Organization for Standardization

Additional WWW server for the ISO (as of 4/30/97, faster access than official site). ISO information including: How to place your order for ISO Standard Publications published by ISO in Geneva, What is ISO?, Technical Committees, Newly Published ISO and IEC Standards, and ISO and IEC Draft International Standards (DIS). H. Ikeda, Computer Engineering, Electronic Systems Division, Department of Electric and Electronics Engineering, Faculty of Engineering, Chiba University, 1-33 Yayoi, Inage, Chiba 263, Japan. Tel: +81 43 290 3352. Fax: 81 43 290 3039. E-mail: ikeda@hike.te.chiba-u.ac.jp. URL: <http://133.82.181.177/ikeda/ISO/home.html>.

International Organization for Standardization: Environmental Management

ISO site dealing with Environmental Management. Information on each of the subcommittees can be found here as well. URL: <http://www.iso.ch/meme/TC207.html>.

U.S. Federal & State Government Websites

Pennsylvania Department of Environmental Protection (DEP) ISO 14000 information site

This site includes ISO 14000 and the Next Generation of Environmental Protection Tools, DEP Looking for ISO 14000 Partners, Privatization of Environmental Regulation, So What is ISO 14000 Anyway?, Going Green With Less Red Tape, ISO 14000: A Building Block for Redefining Environmental, Sustainable Development, and Links to Others Sites With ISO 14000 Information.

E-mail: ASKDEP@a1.dep.state.pa.us.

URL: <http://www.dep.state.pa.us/dep/deputate/pollprev/ISO14000/ISO14000.HTM>.

President's Council on Sustainable Development site

This site includes a message from the Executive Director, General Information, Council Report, Vice President's Speech, Task Force Reports, and Newsletters. E-mail: pcsd@igc.apc.org. URL: <http://www.whitehouse.gov/WH/EOP/pcsd/index.html>

Enviro\$en\$e

Enviro\$en\$e is a pollution prevention and environmental compliance assistance network. Its databases offer full-text and multisite search tools to address technical and regulatory issues with information from a wide spectrum of government, industry, academic, and public interest sources. URL: <http://es.inel.gov/>.

EPA's Partners for the Environment

EPA's Partners for the Environment Web site contains links to many other initiatives including 33/50, Common Sense Initiative (CSI), Design for the Environment, Environmental Leadership Program, EPA Standards Network, and Project XL. E-mail: anderson.joe@epamail.epa.gov. URL: <http://www.epa.gov/partners/>.

The Public Sector Continuous Improvement Site

This site offers suggested reading material, a library of documents available online, organizations of interest, and a guide to online resources. John Hunter, Webmaster, Public Sector Continuous Improvement Site. E-mail: asqcpsn@aol.com. URL: <http://deming.eng.clemson.edu/pub/psci>.

International Websites

Canadian Standards Association

This site includes: Background Standards Information, News and Information, and Member and Technical Committee Services. Canadian Standards Association, 178 Rexdale Boulevard, Etobicoke

(Toronto), Ontario, M9W 1R3. Tel: 800-463-6726, 416-747 4000. Fax: 416-747-4149. E-mail: webmaster@csa.ca. URL: <http://www.csa.ca/toc-prog.htm>.

Central European Environmental Data Request Facility (CEDAR)

This is a project of the Austrian Federal Ministry for the Environment providing information including CEDAR/ISEP, Databases and Resources, CEDAR Mailing List Archives (INFOTERRA, ENVENG-L), Environmentally Relevant Institutions, other interesting links, and CEDAR/ISEP staff. E-mail: webmaster@cedar.univie.ac.at. URL: <http://www.cedar.univie.ac.at/>.

United Nations Environment Programme Geneva Executive Center (Switzerland)

This Web site is maintained by UNEP's Information Unit for Conventions (IUC) to make information from secretariats more widely available. Many environmental resources including: Trade and the Environment and other Web sites on environment and sustainable development. E-mail: Webmaster@unep.ch. URL: <http://www.unep.ch>.

La Planete a Besoin de Nous

French and European Environmental Associations Directory. Tel: 33-01-42-63-34-62. E-mail: adme@worldnet.fr. URL: <http://www.worldnet.fr/~adme>.

Manitoba Pollution Prevention

This home page has link to the Canadian Council of Ministers of Environment, which in turn links to all provincial environment department home pages. URL: <http://www.gov.mb.ca/envIRON>.

Standards Council of Canada

This site includes an article on pressures to create sector specific standards for ISO 14000. [Http://www.scc.ca/consensu/fitall2307.html](http://www.scc.ca/consensu/fitall2307.html)

Industry Websites

IAS Environmental Management Systems (EMS) Registration Program and ISO 14000 Page

International Approval Services (IAS) is a joint venture of the American Gas Association and the Canadian Gas Association EMS Registration Program and ISO 14000 Page that includes: ISO 14000 Introduction; Who - What - Where - When - Why - How of the ISO and ISO 14000; The U.S. Technical Advisory Group (TAG) and Its Role in ISO; What Is An EMS?; ISO 14001 Guidance Document; Benefits of EMS Implementation and Registration; and EMS Assessment Pilot Project. Cleveland Office (Main), 8501 E. Pleasant Valley Road, Cleveland, Ohio 44131. Tel: 800-247-0802 / 216-524-4990. Fax: 216-642-3463. URL: <http://www.gasweb.org/gasweb/ias/iso14000.htm>

Nongovernmental Organization Websites

The Committee for the National Institute for the Environment (CNIE)

CNIE is a national, nonprofit organization working to improve the scientific basis for making decisions on environmental issues through creation of a new, non-regulatory environmental science and education agency. E-mail: cnie@access.digex.net. URL: <http://www.inhs.uiuc.edu/niewww/temp.html>

ISO 14000 West Coast Working Group

This site has the work of several committees from the West Coast of North America as well as general ISO 14000 information. URL: <http://www.wcwg.org>.

University Websites

Asian Institute of Technology (AIT). This site details how to implement ISO 14000.
URL: <http://www.ait.ac.th/AIT/som/as/ISO14000/index.htm>.

Links

EcoNet World-Wide Web pages

This site contains links to the many environmental organizations. Information categories include EcoNet News Of Note; EcoNet New and Featured Items; EcoNet Issue Resource Center (Web sites sorted by category); EcoNet's Directory of Organizations; EcoNet's Environment Gopher; and a search engine for EcoNet's Web site. There is no direct ISO 14000 information. E-mail: econet@igc.apc.org. URL: <http://www.igc.apc.org/econet>.

GLOBE Resource Centre (GRC)

This site has links to Internet environmental business sites. E-mail: grcinfo@globe.apfnet.org. URL: <http://globe1.apfnet.org/>.

Quality Resources Online

This site provides a list of links to other Web resources (sites and mail lists) related to ISO 14000. E-mail: help@quality.org. URL: <http://www.casti.com/qc/html/iso14000.html>.

ISO World

This site provides links to quality and EMS sites, and is the source of free Global Strategic Systems Newsletters. E-mail: db700378@jnet.sumiden.co.jp. URL: <http://www.omninet.co.jp/isoworld/english/english.htm>.

Centre for Economic and Social Studies for the Environment (CESSE)

Information includes activities; studies achieved and/or in progress; selected papers; training programs in the field of environment; and a Directory of Best Environmental Directories. Université Libre de Bruxelles (ULB) 44, Avenue Jeanne, CP 124, B-1050 Brussels, Belgium. Tel: +32-2-650 33 77. Fax: +32-2-650 46.91. E-mail: whecq@ulb.ac.be. URL: <http://www.ulb.ac.be/ceese/cesse.html>.

WWW Virtual Library Environment

This site has links organized by subject and includes a List O' Lists of Environmental Resources. URL: <http://ecosys.drdr.virginia.edu/environment.html>.

MONITORING PERFORMANCE
APPENDIX

Appendix I: Major ASTM Guides and Practices Related to Waste and Site Characterization and Sampling

The following is a topical list of more than 80 American Society for Testing and Materials (ASTM) guides and practices that may be of use when developing a ground-water or vadose zone monitoring system for an industrial nonhazardous waste management facility. The volume in ASTM's *Annual Book of Standards* is indicated at the end of each standard title. Volumes and individual standards can be obtained from ASTM Customer Service, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; 610/832-9585, fax 610/832-9555, website <http://www.astm.org>.

A.1 Waste Characterization and Sampling

A.1.1 General Guidance

- D4687-95 Guide for General Planning of Waste Sampling (Vol. 11.04).
- D5956-96 Guide for Sampling Strategies for Heterogeneous Wastes (Vol. 11.04).
- D6009-96 Guide for Sampling Waste Piles (Vol. 11.04).
- D6044-96 Guide for Representative Sampling and Management of Waste and Contaminated Media (vol. 11.04).
- D6051-96 Guide for Composite Sampling and Field Subsampling For Environmental Waste Management Activities (Vol. 11.04).
- D6063-96 Guide for Sampling of Drums and Similar Containers By Field Personnel (Vol. 11.04).

A.1.2 Specific Sampling Procedures

- D4489-95 Practices for Sampling Waterborne Oils (Vol. 11.02).
- D4547-91 Practice for Sampling Waste and Soils for Volatile Organics (Vol. 11.04).
- D4823-95 Guide for Core-Sampling Submerged, Unconsolidated Sediments (Vol. 11.02).
- D5013-89 Practice for Sampling Wastes from Pipes and Other Point Discharges (Vol. 11.04).
- D5358-93 Practice for Sampling with a Dipper or Pond Sampler (Vol. 11.04).
- D5451-93 Practice for Sampling Using a Trier Sampler (Vol. 11.04).
- D5495-94 Practice for Sampling with a Composite Liquid Waste Sampler (COLIWASA) (Vol. 11.04).
- D5633-94 Practice for Sampling with a Scoop (Vol. 11.04).
- D5658-95 Practice for Sampling Unconsolidated Waste from Trucks (Vol. 11.04).
- D5679-95a Practice for Sampling Consolidated Solids in Drums or Similar Containers (Vol. 11.04).
- D5680-95a Practice for Sampling Unconsolidated Solids in Drums or Similar Containers (Vol. 11.04).
- D5743-95 Practice for Sampling Single or Multilayered Liquids, With or Without Solids in Drums or Similar Containers (Vol. 11.04)

Appendix I: Major ASTM Guides and Practices Related to Waste and Site Characterization and Sampling (cont.)

A.2 Environmental Site Characterization

A.2.1 General Guidance

- D5730-96 Guide to Site Characterization for Environmental Purposes With Emphasis on Soil, Rock, The Vadose Zone and Ground Water (Vol. 4.09).
- D5995-96 Guide for Environmental Site Characterization in Cold Regions (Vol. 4.09).
- D420-93 Guide for Site Characterization for Engineering, Design, and Construction Purposes (Vol. 4.08).
- E1689-95 Guide for Developing Conceptual Site Models for Contaminated Sites (Vol. 11.05).
- PS3-95 Guide for Accelerated Site Characterization for Confirmed or Suspected Petroleum Releases (Vol. 11.04).
- PS85-96 Guide for Expedited Site Characterization of Hazardous Waste Contaminated Sites (Vol. 4.09).

A.2.2 Aerial Photography and Imagery

- D5518-94 Guide for Acquisition of File Aerial Photography and Imagery for Establishing Historic Site-Use and Surficial Conditions (Vol 4.09).

A.2.3 Data Elements

- D5911-95 Practice for a Minimum Set of Data Elements to Describe a Soil Sampling Site (Vol. 4.09).
- D5474-93 Guide for Selection of Data Elements for Ground-Water Investigations (Vol. 4.09).
- D5254-92 Practice for the Minimum Set of Data Elements to Identify a Ground Water Site (Vol. 4.09).
- D5408-93 Guide for the Set of Data Elements to Describe a Ground-Water Site, Part 1--Additional Identification Descriptors (Vol. 4.09).
- D5409-93 Guide for the Set of Data Elements to Describe a Ground-Water Site, Part 2--Physical Descriptors (Vol. 4.09).
- D5410-93 Guide for the Set of Data Elements to Describe a Ground-Water Site, Part 3--Usage Descriptors (Vol. 4.09).

A.2.4 Geologic and Hydrogeologic Characterization

- D5979-96 Guide for Conceptualization and Characterization of Ground Water Flow Systems (Vol. 4.09).
- D6030-96 Guide to Selection of Methods for Assessing Ground Water or Aquifer Sensitivity and Vulnerability (Vol. 4.09).

Appendix I: Major ASTM Guides and Practices Related to Waste and Site Characterization and Sampling (cont.)

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| D5717-95 | Guide for the Design of Ground-Water Monitoring Systems in Karst and Fractured-Rock Aquifers (Vol. 4.09). |
| D5980-96 | Guide for Selection and Documentation of Existing Wells for Use in Environmental Site Characterization and Monitoring (Vol. 4.09). |
| D6067-96 | Guide for Using the Electronic Cone Penetrometer for Environmental Site Characterization (Vol. 4.09). |
| D5434-93 | Guide for Field Logging of Subsurface Explorations of Soil and Rock (Vol. 4.09). |
| D4043-91 | Guide for Selection of Aquifer-Test Field and Analytical Procedures in Determination of Hydraulic Properties by Well Techniques (Vol. 4.08). |
| D5126-90 | Guide for Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone (Vol. 4.09). |
| D6000-96 | Guide for the Presentation of Water-Level Information From Ground Water Sites (Vol. 4.09). |

A.2.5 Geophysical Methods

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| D5753-95 | Guide for Planning and Conducting Borehole Geophysical Logging (Vol. 4.09). |
| D5777-95 | Guide for Using the Seismic Refraction Method for Subsurface Investigations (Vol. 4.09). |

A.2.6 Drilling Methods

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| D5781-95 | Guide for Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |
| D5782-95 | Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |
| D5783-95 | Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |
| D5784-95 | Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |
| D5872-95 | Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |
| D5875-95 | Guide for Use of Cable-Tool Drilling and Sampling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |
| D5876-95 | Guide for Use of Direct Rotary Wireline Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices (Vol. 4.09). |

Appendix I: Major ASTM Guides and Practices Related to Waste and Site Characterization and Sampling (cont.)

A.3 Ground Water Monitoring Wells (see also drilling methods in A.2.6 above)

- D5092-90 Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (Vol. 4.09).
- D5787-95 Practice for Monitoring Well Protection (Vol. 4.09).
- D5521-94 Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers (Vol. 4.09).
- D4750-87 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well) (Vol. 4.09).
- D5978-96 Guide for Maintenance and Rehabilitation of Ground Water Monitoring Wells (Vol. 4.09).
- D5299-92 Guide for the Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices for Environmental Activities (Vol. 4.09).

A.4 Ground Water Sampling

- D5903-95 Guide for Planning and Preparing for a Ground-Water Sampling Event (Vol. 4.09).
- D4448-85a Guide for Sampling Groundwater Monitoring Wells (Vol. 11.04).
- D6001-96 Guide for Direct-push Water Sampling for Geoenvironmental Investigations (Vol. 4.09).

A.5 Vadose Zone Monitoring

- D4700-91 Guide for Soil Sampling from the Vadose Zone (Vol. 4.08).
- D3404-91 Guide to Measuring Matric Potential in the Vadose Zone Using Tensiometers (Vol. 4.08).
- D4696-92 Guide for Pore-Liquid Sampling From the Vadose Zone (Vol. 4.08).
- D5314-92 Guide for Soil Gas Monitoring in the Vadose Zone (Vol. 4.09).
- D5299-92 Guide for the Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices for Environmental Activities (Vol. 4.09).

A.6 Sample Handling

- D5088-90 Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites (Vol. 4.09).
- D4547-91 Practice for Sampling Waste and Soils for Volatile Organics (Vol. 11.04).
- D4840-95 Guide for Sample Chain of Custody Procedure (Vol. 11.01).

Appendix I: Major ASTM Guides and Practices Related to Waste and Site Characterization and Sampling (cont.)

- D4841-88 Practice to Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents (Vol. 11.01).
D4220-95 Practices for Preserving and Transporting Soil Samples (Vol. 4.08).
D5079-90 Practices for Preserving and Transporting Rock Core Samples (Vol. 4.09).

A.7 QA/QC

- D5283-92 Practice for Generation of Environmental Data Related to Waste Management Activities: QA/QC Planning and Implementation (Vol. 11.04).
D5612-94 Guide for the Quality Planning and Field Implementation of a Water Quality Measurement Program (Vol. 11.01).
D5792-95 Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives (Vol. 11.04).
D5851-95 Guide for Planning and Implementing a Water Monitoring Program (Vol. 11.02).

A.8 Data Analysis and Contingency Planning

A.8.1 Statistical Analysis of Ground Water Quality Data

- PS64-96 Guide for Developing Appropriate Statistical Approaches for Ground--Water Detection Monitoring Programs (Vol. 4.09).

A.8.2 Graphic Analysis of Ground Water Quality Data

- D5738-95 Guide for Displaying the Results of Chemical Analyses of Ground Water for Major Ions and Trace Elements -- Diagrams for Single Analyses (Vol. 4.09).
D5754-95 Guide for Displaying the Results of Chemical Analyses of Ground Water for Major Ions and Trace Elements--Trilinear and Other Multi-Coordinate Diagrams (Vol. 4.09).
D5877-95 Guide for Displaying the Results of Chemical Analyses of Ground Water for Major Ions and Trace Elements -- Diagrams Based on Data Analytical Calculations (Vol. 4.09).
D6036-96 Guide for Displaying the Results of Chemical Analyses of Ground Water for Major Ions and Trace Elements--Use of Maps (Vol. 4.09).

A.8.3 Geostatistical Analysis of Environmental Data

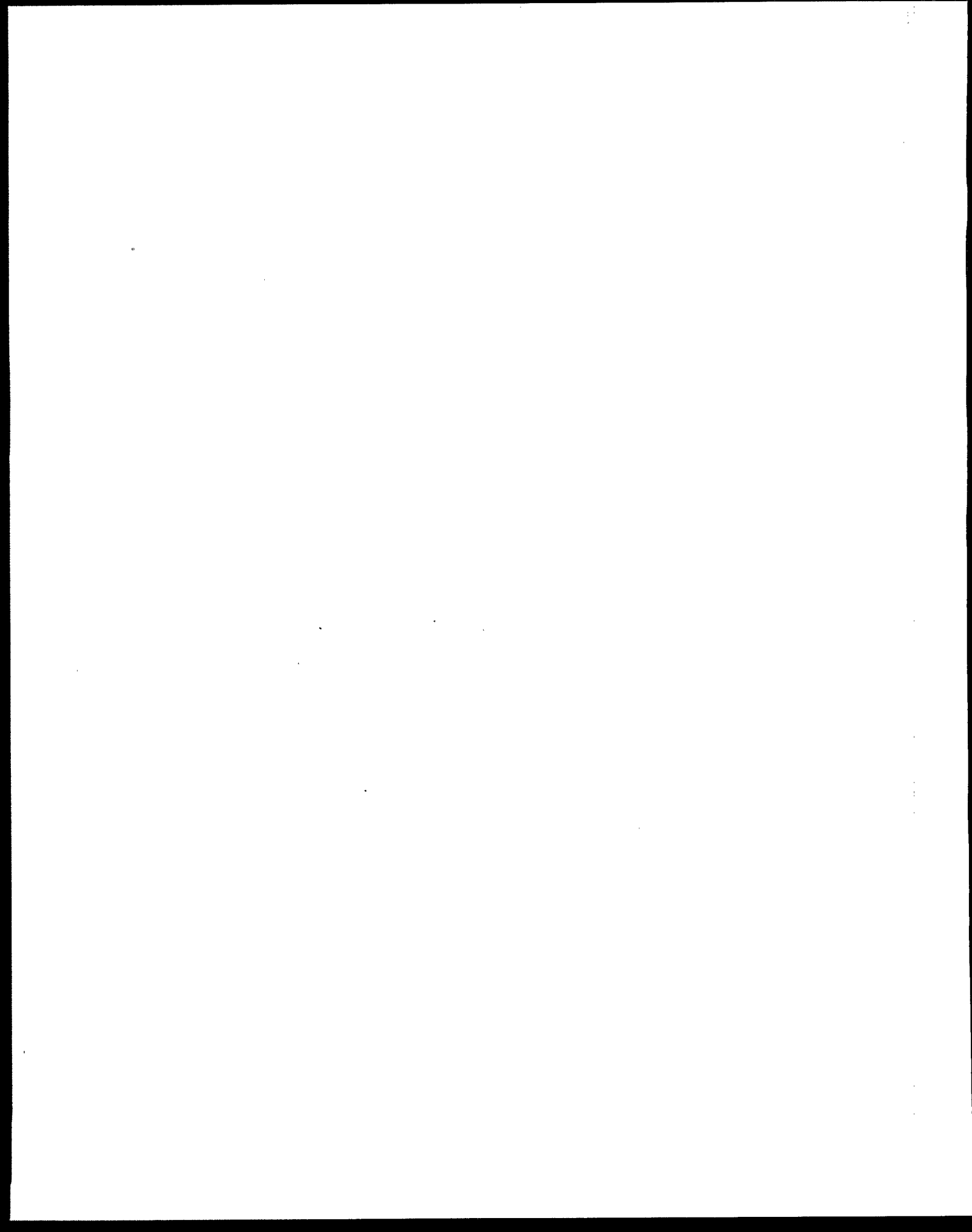
- D5549-94 Guide for Reporting Geostatistical Site Investigations (Vol. 4.09).
D5922-96 Guide for Analysis of Spatial Variation in Geostatistical Site Investigations (Vol. 4.09).

Appendix I: Major ASTM Guides and Practices Related to Waste and Site Characterization and Sampling (cont.)

- D5923-96 Guide for the Selection of Kriging Methods in Geostatistical Site Investigations (Vol. 4.09).
- D5924-96 Guide for the Selection of Simulation Approaches in Geostatistical Site Investigations (Vol. 4.09).

A.8.4 Contingency Planning

- D5745-95 Guide for Developing and Implementing Short-Term Measures or Early Actions for Site Remediation (Vol. 11.04).



TAKING CORRECTIVE ACTION
APPENDICES

Appendix I: Examples of Interim Corrective Measures

The following is a list of possible interim measures for various waste management units and release types. This list is not considered to be all-inclusive. More information is available through the *Interim Measures Guidance - Interim Final* (U.S. EPA, 1988).

I. Containers

- Overpack or redrum
- Construct storage area; move to new storage area
- Segregation
- Sampling and analysis
- Treatment, storage, and/or disposal
- Temporary cover

II. Tanks

- Overflow; secondary containment
- Leak detection or repair; partial or complete removal

III. Surface Impoundments

- Reduce head
- Remove free liquids and highly mobile wastes
- Stabilize or repair side walls, dikes, or liner(s)
- Temporary cover
- Run-on or run-off control (diversion or collection devices)
- Sample and analyze to document the concentration of constituents
- Interim ground-water measures

IV. Landfills

- Run-on or run-off control (diversion or collection devices)
- Reduce head or liner and/or leachate collection system
- Inspect leachate collection, removal system, or french drain
- Repair leachate collection, removal system, or french drain
- Temporary cap
- Waste removal
- Interim ground-water measures

V. Waste Piles

- Run-on or run-off control (diversion or collection devices)
- Temporary cover
- Waste removal
- Interim ground-water measures

Appendix I: Examples of Interim Corrective Measures (cont.)

VI. Soils

- Sampling or analysis; disposal
- Run-on or run-off control (diversion or collection devices)
- Temporary cap or cover

VII. Ground Water

- Delineation or verification of gross contamination
- Sampling and analysis
- Interceptor trench, sump, or subsurface drain
- Pump-and-treat; in-situ treatment
- Temporary cap or cover

VIII. Surface-water Releases (Point and Non-Point)

- Overflow or underflow dams
- Filter fences
- Run-on or run-off control (diversion or collection devices)
- Regrading or revegetation
- Sample and analyze surface waters and sediments or point source discharges

IX. Gas Mitigation Control

- Barriers, collection, treatment, or monitoring

X. Particulate Emissions

- Truck wash (decontamination unit)
- Revegetation
- Application of dust suppressant

XI. Other Actions

- Fencing to prevent direct contact
- Sampling offsite areas
- Alternate water supply to replace contaminated drinking water
- Temporary relocation of exposed population
- Temporary or permanent injunction

Appendix II: Ground-Water Containment Technologies

This appendix briefly describes several commonly used technologies to contain contaminated ground water.

I. Ground-Water Pumping

Ground-water pumping can be used to manipulate and manage ground water for the purpose of removing, diverting, and containing a contaminated plume or for adjusting ground-water levels to prevent plume movement. For example, pumping systems consisting of a series of extraction wells located directly downgradient from a contaminated source can be used to collect the contaminated plume. Water can also be injected into the subsurface to move the plume away from an area that must be protected, such as a domestic drinking water source. The success of any contaminant capture system based upon pumping wells is dependent upon the rate of ground-water flow and the rate at which the well is pumped. Thus, the zone of capture for the pumping system must be established.

II. Subsurface Drains

Pumping techniques represent an aggressive approach which requires ongoing maintenance and operation throughout the life of the corrective measure. By contrast, subsurface drains (and barrier walls, described below) represent a passive design, which do not require a high level of ongoing maintenance. Subsurface drains are most useful in preliminary containment applications for controlling pollutant migration, while a final treatment design is developed and implemented. They also provide a measure of long-term protection against residual contaminants following conclusion of treatment and site closure.

Subsurface drains are essentially permeable barriers designed to intercept the ground-water flow. The water must be collected at a low point and pumped or drained by gravity to the treatment system. Subsurface drains can also be used to isolate a waste disposal area by intercepting the flow of uncontaminated ground water before it enters into a contaminated site.

III. Barrier Walls

Low permeability barriers are used to direct the uncontaminated ground-water flow around the disposal site or to prevent the contaminated material from migrating from the site. Barrier walls can be made of a wide variety of materials, as long as they have a lower permeability than the aquifer. Typical materials include mixtures of soil and bentonite, mixtures of cement and bentonite, or barriers of engineered materials (sheet piling). A chemical analysis of wall/contaminant compatibility is necessary to the final selection of materials. The installation of a low permeability barrier usually entails a great deal of earth moving, requires a significant amount of land area, and is expensive. Once in place, however, it represents a long-term, low maintenance system. Active gradient controls, such as pumping and treating contaminated ground water, installed after the barrier wall is in place will add to the long term operating costs of these systems.

Appendix III: Treatment Technologies

This appendix provides a brief overview of the five major treatment technology categories: ground-water pump-and-treat, chemical treatment, biological treatment, thermal treatment, and stabilization which may be used as part of the corrective action plan for a given site.

I. Ground-Water Pump-and-Treat

Pump-and-treat is one of the most widely used ground-water remediation technologies. Conventional pump-and-treat methods involve pumping contaminated water to the surface for treatment. Variations and enhancements of a conventional pump-and-treat system include hydraulic fracturing as well as chemical and biological enhancements. Although the effectiveness of pump-and-treat systems has been called into question, after two decades of use, this approach remains a necessary component of most ground-water remediation efforts and is appropriate for both restoration and plume containment.

Pump-and-treat systems are used primarily for hydraulic containment and treatment to reduce the dissolved contaminant concentrations in ground water sufficiently, so that the aquifer complies with clean-up standards or the treated water withdrawn from the aquifer can be put to beneficial use. Although hydraulic containment and clean-up can represent separate goals, more typically, remediation efforts are undertaken to achieve a combination of both.

Any ground-water clean-up effort will be undermined, unless inorganic and organic contaminant sources are identified, located, and eliminated, or at least controlled, to prevent further contamination of the aquifer. Toxic inorganic substances may serve as a continuing source of contamination through mechanisms such as dissolution and desorption. Source removal is the most effective way to prevent further contamination.

Comprehensive characterization of the contaminated site helps to accurately assess the types, extent, and forms of contamination in the subsurface and increases the likelihood of achieving treatment goals. A thorough, three-dimensional characterization of subsurface soils and hydrogeology, including particle-size distribution, sorption characteristics, and hydraulic conductivity, provides a firm basis for appropriate placement of pump-and-treat wells. To be effective, however, pump-and-treat efforts must go beyond initial site characterization, using information gathered after remediation operations are under way to manage the well extraction field dynamically. Dynamic management of the well extraction field based on more comprehensive information can provide both economic and environmental benefits. In general, additional information about the site and the pump-and-treat effort allows operators to make more informed decisions about the efficient use of remediation resources.

A key component of the dynamic management approach is the effective design and operation of the pump-and-treat system. The following techniques can be useful in this regard:

- Using capture zone analysis, optimization modeling, and data obtained from monitoring the effects of initial extraction wells to identify the best locations for wells;
- Phasing the construction of extraction and monitoring wells so that information obtained from operation of the initial wells informs decisions about siting subsequent wells; and

Appendix III: Treatment Technologies (cont.)

- Phasing pumping rates and the operation of individual wells to enhance containment, avoid stagnation zones, and ensure removal of the most contaminated ground water first.

The basic operating principle of a pump-and-treat system calls for locating a well (or wells) and then pumping at rates that cause all water in a contaminant plume to enter the well rather than continue traveling through the subsurface. In recent years, numerous mathematical models have been developed or applied to compute capture zone, ground-water pathlines, and associated travel times to extraction wells or drains. For relatively simple hydrogeologic settings (homogeneous isotropic aquifers), analytical equations solved manually, using graphical techniques or computer codes based on analytical solutions, may be adequate. For more complex sites, numerical computer models may be required. These models provide insight to flow patterns generated by alternative pump-and-treat approaches and to the selection of monitoring points and frequency.

Removal of contaminated ground water should be a dynamic process that uses information on the response of the ground-water system to improve the efficiency of pumping operations. Elements of efficient pumping operations can include:

- Combined plume containment and source remediation;
- Phased construction of extraction wells to allow data on the monitored response of the aquifer to pumping operations to be used in siting subsequent wells;
- Adaptive pumping so that extraction and injection can be varied to reduce zones of stagnation; and
- Pulsed pumping to increase the ratio of contaminant mass removed to ground-water volume where mass transfer limitations restrict dissolved contaminant concentrations.

Once extraction wells have brought contaminated water to the surface, treatment is relatively straightforward, provided that appropriate methods have been selected, and the capacity of the treatment facility is adequate.

II. Chemical Treatment

Chemical treatment is a class of processes in which specific chemicals are added to wastes or to contaminated media in order to achieve detoxification. Depending on the nature of the contaminants, the chemical processes required may include pH adjustment, lysis, oxidation, reduction, or a combination of these. Thus, chemical treatment is used to effect a chemical transformation of the waste to an innocuous or less toxic form. In addition, chemical treatment is often used to prepare for or facilitate the treatment of wastes by other technologies.

In general, chemical treatment processes are applicable to a broad range of organic and inorganic wastes. For example, they can be used for the oxidation of organics, for pH adjustment to precipitate heavy metals, and for lysis of chlorinated organics to cleave chlorine atoms from

Appendix III: Treatment Technologies (cont.)

organic molecules in preparation for subsequent oxidative processes. Chemical treatment processes rely on the intimate mixing of reagents with the waste. Thus, the wastes generally treated by chemical means must be in an aqueous or slurry form.

Chemical treatment processes can generally be implemented either ex-situ or in-situ. In-situ treatment can be used, when it is uneconomical to haul or when infeasible or uneconomical to dig or pump the contaminated waste matrix for treatment in a reactor. This approach should be used whenever excavation or removal causes an increased threat to human health; it can reduce the cost of a remediation program. Because chemicals are applied to the contaminated waste matrix, specifically soil and ground water, a potential exists for reaction with the soil. Permeability problems can occur as the result of precipitate formation. This can result in inadequate mixing of the contaminant with the treatment chemical and gas generation.

A brief description of the three major chemical treatment options pH adjustment, oxidation and reduction processes, and lysis processes are provided below.

A. pH Adjustment

The function of pH adjustment is to neutralize acids and bases and to promote the formation of precipitates, which can subsequently be removed by conventional settling techniques. These purposes are not mutually exclusive; precipitates can be formed as the result of neutralizing a waste. Conversely, neutralization of the waste stream can result when adjusting the pH to effect chemical precipitation. Typically, pH adjustment is effective in treating inorganic or corrosive wastes.

B. Oxidation and Reduction Processes

Oxidation and reduction must both take place in any such reaction. In any oxidation reaction, the oxidation state of one compound is raised (i.e., oxidized) while the oxidation state of another compound is lowered (i.e., reduced). Oxidation and reduction reactions are utilized to change the chemical form of a hazardous material, in order to render it less toxic or to change its solubility, stability, separability, or otherwise change it for handling or disposal purposes. In the reaction, the compound supplying the oxygen (or chlorine or other negative ion) is called the oxidizer or oxidizing agent, while the compound accepting the oxygen (i.e., supplying the positive ion) is called the reducing agent. The reaction can be enhanced by catalysis, electrolysis, or photolysis.

C. Lysis Processes

The basic function of lysis processes is to split molecules to permit further treatment. Hydrolysis is a chemical reaction in which water reacts with another substance. In the reaction, the water molecule is ionized while the other compound is split into ionic groups. Photolysis, another lysis process, breaks chemical bonds by irradiating a chemical with ultraviolet light. Catalysis uses a catalyst to achieve bond cleavage.

III. Biological Treatment

Biological treatment is a destruction process relying primarily on oxidative or reductive

Appendix III: Treatment Technologies (cont.)

mechanisms. Enzymatic activity can effect lysis (e.g., hydrolysis or dehalogenation). Further, biological activity can result in pH changes in the waste stream which may require adjustment by chemical means. The use of biological treatment processes is directed toward accomplishing (1) destruction of organic contaminants, (2) oxidation of organic chemicals whereby the organic chemicals are broken down into smaller constituents, and (3) dehalogenation of organic chemicals by cleaving a chlorine atom(s) or other halogens from a compound. Biological treatment processes have certain advantages over other common treatment technologies, such as the organic contaminants to be destroyed are used and transformed by bacteria or other organisms as a source of food. These processes can be employed in soils, slurries, or waters (such as ponds or ground water) to aid in the remediation of a site.

Biological processes can be used on a broad class of biodegradable organic contaminants. Some compounds, called refractiles, are persistent compounds which are not readily biodegradable. It should be noted that very high concentrations as well as very low concentrations of organic contaminants are difficult for biological processes to treat.

Biological treatment processes can be used to treat organic contaminants in liquid, slurry, and soil matrices. However, it should be remembered that moisture is an essential need of the biomass both for growth and to provide mobility either of the food to the biomass or the biomass to the organic. Thus, matrices which do not have sufficient moisture will not support biodegradation, and methods to add moisture may have to be engineered into the system.

Since microorganisms need appropriate conditions in which to function, an engineer must provide an optimum environment, whether aboveground in a reactor or belowground for an in-situ application. The primary environmental factors which can affect the growth of the microbial community, in addition to providing them sufficient food (organic material), are pH, temperature, oxygen concentration, nutrients, and toxicity.

pH. Typically, the biological treatment system operates best when a waste stream is at a pH near 7. However, waste treatment systems can operate (with some exceptions) between pH values of 4 and 10. The exceptions are aerobic systems in which ammonia is oxidized to NO_x as well as anaerobic methane fermentation systems. For these, the pH should be between 6 and 8. At the extremes of this range, the system will function, but efficiency will suffer.

Temperature. Waste treatment systems can function over a very wide temperature range of 5 to 60 C. However, there are three rather distinct ranges in which different groups of organisms function:

■	Psychrophilic	<15 C
■	Mesophilic	15 to 45 C
■	Thermophilic	>45 C

Most waste treatment systems operate in the mesophilic region. The expense of altering the temperature of wastes encountered in abnormally cold or warm environments indicates the desirability of developing organisms which are suited to extremes of ambient waste temperatures.

Oxygen. Microorganisms need a certain amount of oxygen not only to survive but also to mediate their reactions. Therefore, the residual dissolved oxygen concentrations should be

Appendix III: Treatment Technologies (cont.)

maintained at approximately 2 mg/l or greater within a typical liquid biotreatment system. Having this much oxygen "left over" indicates that sufficient oxygen was available for the biological process.

Nutrients. Nutrients can be classified into three groups based on levels required in waste treatment systems. The major nutrients can be identified from the generalized biomass formula ($C_60H_{82}O_{23}N_{12}P$). The actual quantity needed depends on the biochemical oxygen demand (BOD) of the waste. The higher the BOD, the greater the quantity of cells produced. The minor and trace nutrients are needed in small quantities and are given in terms of concentration, because these are the levels needed in solution to force the small amount required inside the cell across the cell-wall membrane.

Toxicity. The presence of toxic substances will obviously produce adverse conditions in a biological system. Unfortunately, it is difficult to cite specific toxic materials because toxicity depends on concentration. All of the nutrients previously mentioned can be toxic if their concentration is excessive. All types of organic compounds which can be used as food by bacteria can be toxic if the level is high enough. Thus, our concept of a toxic substance is a substance which is toxic at a very low concentration. In addition, phenomena such as acclimation, antagonism, and synergism will alter toxicity effects. Frequently, toxicity concerns can be avoided by waste dilution and by microbe acclimation. Acclimation is most important when dealing with "toxic waste." For example, with acclimated biomass, a few milligrams per liter of phenol can produce toxicity; but after acclimation, waste treatment systems can easily handle wastes containing up to 500 mg/l of phenol.

The two types of biological treatment processes, aerobic and anaerobic, are described below.

A. Aerobic Processes

Aerobic processes are oxidative processes and are the most widely used biological treatment processes for organic wastes. These processes rely on providing the basic environmental conditions required for biological growth but use differing methods for maintaining the microorganisms in the system and contacting the organic material with the biomass. Since these systems require a supply of molecular oxygen, the cost of supplying oxygen frequently sets an economic limit on the concentration of organics which can be present in the wastewater. For conventional systems, a limit of approximately 10,000 mg/l BOD is a good rule of thumb. For situations where the flow is low, however, higher concentrations can be economically biodegraded. Engineered aerobic processes include suspended growth systems, fixed-film systems, hybrid reactors, and in-situ application.

B. Anaerobic Processes

Anaerobic treatment of hazardous wastes has not been widely used in aboveground reactors or in-situ. All anaerobic biological treatment processes achieve the reduction of organic matter to methane and carbon dioxide in an oxygen-free environment. This is accomplished by using cultures of bacteria which include facultative and obligate anaerobes. Anaerobic bacterial systems include hydrolytic bacteria (catabolize saccharides, proteins, lipids); hydrogen producing

Appendix III: Treatment Technologies (cont.)

acetogenic bacteria (catabolize the products of hydrolytic bacteria, such as fatty acids and neutral end products); homolactic bacteria (catabolize multicarbon compounds to acetic acid); and methanogenic bacteria (metabolize acetic and higher fatty acids to methane and carbon dioxide). The strict anaerobes require totally oxygen-free environments and oxidation reduction potentials of less than -0.2V. Micro-organisms in this group are commonly referred to as methanogenic consortia and are found in anaerobic sediments or sewage sludge digesters. These organisms play an important role in reductive dehalogenation reactions, nitrosamine degradation, reduction of epoxides to olefins, reduction of nitro groups, and ring fission of aromatic structures. Available anaerobic treatment concepts are based on such approaches as the classic well-mixed system, the two-stage system, and the fixed bed.

IV. Thermal Treatment

Incineration can be applied to most organic-bearing wastes under various conditions. Wastes may be burned which contain relatively high water content, are largely inorganic in nature (meaning they possess high ash content), or are in the solid or semi-solid state. To decide whether incineration is the best technology for a specific waste, consideration must be given to the following issues:

- Limitations which arise from the quantity or nature of the waste;
- The environmental impact of incineration, including stack and fugitive emissions;
- The requirements for disposal of residues such as ash and air pollution control residues; and
- Permitting issues.

Incineration is an oxidative process which is used for detoxification and sterilization, volume reduction, energy recovery, and by-product chemical recovery. The incineration process may be viewed as consisting of four parts:

- Preparation of the feed materials for placement in the incinerator (pretreatment);
- Incineration or combustion of the material in a combustion chamber;
- Cleaning of the resultant air stream by air pollution control devices; and
- Disposal of the residues from the application of the process.

Thermal processes are typically used for highly toxic waste or highly concentrated organic wastes. If the waste contains PCBs, dioxins, or other toxic substances, incineration should be chosen in order to assure destruction. If the wastes contain greater than 1,000 parts per million of halogens (chlorinated materials), it would probably be desirable to select incineration of these wastes, after consideration of other options. In any case, a material may be incinerated or used as a fuel if the heat content is greater than 8,500 BTUs per pound or, if between 2,500 and 8,500 BTUs, it may be incinerated with auxiliary fuel. The waste components of concern are halogens, alkali metals, and heavy metals. Incineration processes are available to destroy organics in liquids, solids/sludges, soils and gases.

The types of incinerators which can be employed for incineration of liquid wastes include:

- Liquid injection furnaces;

Appendix III: Treatment Technologies (cont.)

- Plasma arc incinerators; and
- Rotary kilns.

The thermal processes applicable to detoxify organics in a solid/sludge matrix include the following incinerators:

- Rotary kiln;
- Fluidized bed;
- Circulating bed; and
- Infrared.

Applications of thermal processes to contaminated soils are somewhat limited. Two processes, rotary kiln and in-situ vitrification, offer a mechanism to detoxify organic contaminated soils.

V. Stabilization

The intent of stabilization/solidification processes is to immobilize toxic or hazardous constituents in a waste by:

- Changing the constituents into immobile forms;
- Binding them in an immobile, insoluble matrix; and/or
- Binding them in a matrix which minimizes the waste material surface exposed to solvent.

Often, the immobilized product has a structural strength sufficient to prevent fracturing over time. Solidification accomplishes the intended objective by changing a non-solid waste material into a solid, monolithic structure that ideally will not permit liquids to percolate into or leach materials out of the mass. Stabilization, on the other hand, binds the hazardous constituents into an insoluble matrix or changes the hazardous constituent to an insoluble form. Other objectives of solidification/stabilization processes are to improve handling of the waste and produce a stable solid (no free liquid) for subsequent use as a construction material or for landfilling.

Waste characteristics such as organic content, inorganic content, viscosity, and particle size distribution can affect the quality of the final solidified product. These characteristics inhibit the solidification process by affecting: the compatibility (or incompatibility) of the binder and the waste; the completeness of encapsulation; and the development of preferential paths for leaching due to spurious debris in the waste matrix. Selection of any particular technique for waste treatment must include careful consideration of the intended purpose for the action, the cost of processing, the increase in bulk of material produced, and the changes in the handling characteristics of the resultant by-products. The design and location of any placement area or landfill that eventually receives the treated waste is also a major consideration in deciding on the physical properties that will be required of the stabilization process.

Major categories of industrial waste solidification/stabilization systems are cement-based processes, pozzolanic processes (not including cement), thermoplastic techniques, organic polymer techniques, surface encapsulation techniques, and self-cementing techniques (for high calcium sulfate sludges). Vitrification can also be considered a solidification process.

Appendix IV: Treatment Technologies Screening Matrix

Rating Codes ■ - Better; ○ - Average; △ - Worse. ◆ - See Definition in Table 3-1a. Y - Yes; N - No. F - Full; P - Pilot. S - Solid; L - Liquid; V - Vapor. NA - Not Applicable I - Inadequate. O&M - Operation & Maintenance; Cap - Capital; B - Both	Development Status	Treatment Train (excludes off-gas treatment)	Residuals Produced	O&M or Capital Intensive	Availability	System Reliability/ Maintainability	Cleanup Time	Overall Cost	Nonhalogenated VOCs	Halogenated VOCs	Nonhalogenated SVOCs	Halogenated SVOCs	Fuels	Inorganics	Radionuclides	Explosives
Soil, Sediment, and Sludge																
3.1 In Situ Biological Treatment																
4.1 Bioventing	F	N	N	N	◆	◆	◆	■	■	◆	◆	◆	■	△	◆	I
4.2 Enhanced Bioremediation .. Aerobic .. Anaerobic	F	N	N	O&M	◆	◆	◆	◆	■	■	◆	◆	■	◆	◆	■
4.3 Land Treatment	F	N	N	N	◆	◆	◆	◆	■	■	◆	◆	■	△	◆	◆
4.4 Natural Attenuation	F	N	N	O&M	◆	◆	△	◆	■	◆	◆	◆	◆	◆	◆	◆
4.5 Phytoremediation .. Enhanced Rhizosphere Biodegradation .. Phyto-accumulation .. Phyto-degradation .. Phyto-stabilization	P	N	N	N	△	○	△	■	○	○	○	○	■	△	△	■
3.2 In Situ Physical/Chemical Treatment																
4.6 Electrokinetic Separation	F	Y	L	O&M	■	○	○	○	○	○	○	○	△	■	○	△
4.7 Fracturing .. Blast-Enhanced .. Lasagna Process .. Pneumatic Fracturing	F	Y	N	O&M	△	○	○	○	○	○	○	○	○	○	△	○
4.8 Soil Flushing .. Cosolvents Enhancement	F	N	L	O&M	■	○	△	△	■	■	○	○	○	■	△	△
4.9 Soil Vapor Extraction	F	N	L	O&M	■	■	○	■	■	■	○	○	■	△	△	△
4.10 Solidification/Stabilization	F	N	S	B	○	○	○	○	■	■	■	■	△	■	■	△

Appendix IV: Treatment Technologies Screening Matrix (cont.)

3.3 In Situ Thermal Treatment																
4.11 Thermally Extraction .. Electrical Resistance Heating .. Radio Frequency/ Electromagnetic Heating .. Hot Air Injection	P	N	N	N	△	■	△	■	○	○	■	■	■	△	△	△
3.4 Ex Situ Biological Treatment (assuming excavation)																
4.12 Biopiles	F	N	N	N	■	■	○	■	■	■	◆	◆	■	◆	△	■
4.13 Composting	F	N	N	N	■	■	○	■	■	■	◆	◆	■	◆	△	■
4.14 Fungal Biodegradation .. White Rot Fungus	F	N	N	O&M	△	△	△	■	◆	◆	◆	◆	◆	△	△	■
4.15 Landfarming	F	N	N	N	■	■	△	■	■	■	◆	◆	■	◆	△	◆
4.16 Slurry Phase Biological Treatment	F	N	N	B	○	○	○	○	■	■	◆	◆	■	◆	△	■
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)																
4.17 Chemical Extraction .. Acid Extraction .. Solvent Extraction	F	Y	L	B	○	○	△	△	○	○	■	■	○	■	○	■
4.18 Chemical Reduction /Oxidation	F	Y	S	N	■	■	■	○	○	○	○	○	○	■	△	△
4.19 Dehalogenation .. Base-Catalyzed Decomposition .. Glycolate/Alkaline Polyethylene Glycol (A/PEG)	F	N	V	B	△	△	△	△	○	○	○	○	△	△	△	△
4.20 Separation .. Gravity Separation .. Magnetic Separation .. Sieving/Physical Separation	F	Y	S	O&M	■	○	■	○	○	○	○	○	■	■	△	△
4.21 Soil Washing	F	Y	S L	B	■	○	■	○	○	○	■	■	■	■	△	■
4.22 Soil Vapor Extraction	F	N	L	N	■	■	○	■	■	■	○	○	○	△	△	△
4.23 Solar Detoxification	P	N	N	Cap.	○	○	○	■	■	■	■	■	■	△	△	■
4.24 Solidification /Stabilization .. Bituminization .. Emulsified Asphalt .. Modified Sulfur Cement .. Polyethylene Extrusion .. Pozzolan/Portland Cement .. Radioactive Waste Solidification .. Sludge Stabilization .. Soluble Phosphates .. Vitrification/Molten Glass	F	N	S	Cap.	■	■	■	○	△	△	○	○	△	■	■	△

Appendix IV: Treatment Technologies Screening Matrix (cont.)

3.6 Ex Situ Thermal Treatment (assuming excavation)																
4.25 Hot Gas Decontamination	P	N	N	B	○	■	■	■	△	△	△	△	△	△	△	■
4.26 Incineration .. Circulating Bed Combustor .. Fluidized Bed .. Infrared Combustion .. Rotary Kiln	F	N	L S V	B	■	○	■	△	■	■	■	■	■	△	△	■
4.27 Open Burn/Open Detonation	F	N	S	B	■	■	■	■	△	△	△	△	△	△	△	■
4.28 Pyrolysis .. Fluidized Bed .. Molten Salt Destruction .. Rotary Kiln	F	N	L S	B	△	I	■	△	○	○	■	■	○	△	△	I
4.29 Thermal Desorption .. High Temperature .. Low Temperature	F	Y	L S	B	■	○	■	○	■	■	■	■	■	△	△	■
3.7 Containment																
4.30 Landfill Cap .. Asphalt/Concrete Cap .. RCRA Subtitle C Cap .. RCRA Subtitle D Cap	NA	N	NA	N	■	■	△	■	○	○	○	○	○	○	△	○
4.31 Landfill Cap Enhancements .. Water Harvesting .. Vegetative Cover	NA	N	NA	N	■	■	△	■	○	○	○	○	○	○	△	○
3.8 Other Treatment																
4.32 Excavation, Retrieval, and Off-Site Disposal	NA	N	NA	N	■	■	■	△	○	○	○	○	○	○	△	○
Ground Water, Surface Water, and Leachate																
3.9 In Situ Biological Treatment																
4.33 Co-metabolic Treatment	P	N	N	O&M	△	◆	◆	◆	■	◆	■	◆	◆	△	△	○
4.34 Enhanced Biodegradation .. Nitrate Enhancement .. Oxygen Enhancement with Air Sparging .. Oxygen Enhancement with Hydrogen Peroxide	F	N	N	O&M	■	◆	◆	◆	■	◆	■	◆	■	△	△	○
4.35 Natural Attenuation	F	N	N	O&M	■	◆	◆	◆	◆	◆	◆	◆	◆	△	△	△
4.36 Phytoremediation .. Enhanced Rhizosphere Biodegradation .. Hydraulic Control .. Phyto-Degradation .. Phyto-Volatilization	P	N	N	N	○	■	△	■	○	○	○	○	○	■	△	■

Appendix IV: Treatment Technologies Screening Matrix (cont.)

3.10 In Situ Physical/Chemical Treatment																	
<u>4.37 Aeration</u>	F	Y	V	N	■	○	■	■	■	■	○	○	■	△	△	△	
<u>4.38 Air Sparging</u>	F	Y	V	N	■	■	■	■	■	■	△	△	■	△	△	△	
<u>4.39 Bioslurping</u>	F	Y	L V	N	■	○	○	■	○	○	■	■	■	△	△	○	
<u>4.40 Directional Wells (enhancement)</u>	F	N	NA	Cap.	△	○	■	I	○	○	○	○	○	○	△	○	
<u>4.41 Dual Phase Extraction</u>	F	Y	L V	O&M	■	○	○	○	■	■	△	△	■	△	△	△	
<u>4.42 Fluid/Vapor Extraction</u>	F	Y	L V	O&M	■	○	○	○	■	■	○	○	■	△	△	△	
<u>4.43 Hot Water or Steam Flushing/Stripping</u>	P	Y	L V	Cap.	■	△	■	○	○	○	■	■	■	△	△	△	
<u>4.44 Hydrofracturing</u>	P	Y	N	N	I	■	■	○	○	○	○	○	○	○	△	○	
<u>4.45 In-Well Air Stripping</u> .. Circulating Wells	P	Y	L V	Cap.	■	■	○	○	■	■	○	○	■	I	△	△	
<u>4.46 Passive /Reactive Treatment Walls</u> .. Funnel and Gate .. Iron Treatment Wall	F	N	S	Cap.	■	I	△	I	■	■	■	■	○	■	△	■	
3.11 Ex Situ Biological Treatment																	
<u>4.47 Bioreactors</u>	F	N	S	Cap.	■	○	○	■	■	■	■	◆	■	△	△	■	
<u>4.48 Constructed Wetlands</u>	F	N	S	Cap.	△	◆	◆	○	○	○	○	◆	○	■	△	■	
3.12 Ex Situ Physical/Chemical Treatment (assuming pumping)																	
<u>4.49 Adsorption/ Absorption</u> .. Activated Alumina .. Forager Sponge .. Lignin Adsorption/ Sorptive Clays .. Synthetic Resins	P	N	S	I	○	I	I	△	○	○	○	○	△	■	◆	△	
<u>4.50 Air Stripping</u>	F	N	L V	O&M	■	■	○	■	■	■	○	○	○	△	△	△	
<u>4.51 Granulated Activated Carbon (GAC)/Liquid Phase Carbon Adsorption</u>	F	N	S	O&M	■	■	■	◆	■	■	■	■	○	△	△	△	
<u>4.52 Ion Exchange</u>	F	Y	S	N	■	■	○	■	△	△	△	△	△	■	○	△	
<u>4.53 Precipitation/ Coagulation /Flocculation</u> .. Coagulants and Flocculation	F	Y	S	N	■	■	○	■	△	△	△	△	△	■	○	I	

Appendix V: Treatment Technologies Screening Matrix (cont.)

4.54 Separation .. Distillation .. Filtration/ Ultrafiltration /Microfiltration .. Freeze Crystallization .. Membrane Pervaporation .. Reverse Osmosis	F	Y	S	B	■	■	■	△	■	■	■	■	■	◆	◆	△
4.55 Sprinkler Irrigation .. Trickling Filter	F	Y	S L	N	■	○	○	■	■	■	■	■	■	△	△	△
4.56 UV Oxidation .. UV Photolysis	F	N	N	B	■	△	NA	○	■	■	■	■	■	△	△	■
3.13 Containment																
4.57 Deep Well Injection	F	N	S L	N	■	○	NA	■	○	○	○	○	○	○	○	○
4.58 Ground Water Pumping .. Surfactant Enhanced Recovery .. Drawdown Pumping	F	N	L	B	■	■	NA	△	○	○	○	○	○	○	△	○
4.59 Slurry Walls	F	N	NA	Cap.	■	■	■	■	○	○	○	○	○	○	△	○
3.14 Air Emissions/Off-Gas Treatment																
4.60 Biofiltration	F	NA	S L	N	○	◆	■	■	■	◆	◆	◆	■	△	NA	◆
4.61 High Energy Destruction .. High Energy Corona .. Tunable Hybrid Plasma Reactor	P	NA	N	I	△	△	NA	○	■	■	■	■	■	○	NA	△
4.62 Membrane Separation	P	NA	N	I	△	△	NA	○	■	■	○	○	○	△	NA	○
4.63 Oxidation .. Catalytic Oxidation .. Internal Combustion Engine Oxidation .. Thermal Oxidation .. Ultraviolet Oxidation	F	NA	N	N	■	■	NA	■	■	■	■	■	■	△	NA	○
4.64 Vapor Phase Carbon Adsorption .. VOC Recovery and Recycle	F	NA	S	N	■	■	NA	■	■	■	■	■	■	○	NA	■

Appendix V: A Citizen's Guide to Innovative Treatment Technologies

United States
Environmental Protection
Agency

Solid Waste and
Emergency Response
(5102G)

EPA 542-F-96-001
April 1996



A Citizen's Guide to Innovative Treatment Technologies

For Contaminated Soils, Sludges, Sediments, and Debris

Technology Innovation Office

Technology Fact Sheet

What are innovative treatment technologies?

Treatment technologies are chemical, biological, or physical processes applied to hazardous waste or contaminated materials to permanently change their condition. This Citizen's Guide focuses on treatment technologies for soil, sludge, sediment, and debris.

Treatment technologies destroy contaminants or change them so that they are no longer hazardous or, at least, are less hazardous. They may reduce the amount of contaminated material at a site, remove the component of the waste that makes it hazardous, or immobilize the contaminant within the waste.

Innovative treatment technologies are newly invented processes that have been tested and used as treatments for hazardous waste or other contaminated materials, but still lack enough information about their cost and how well they work to predict their performance under a variety of operating conditions.

Why use an innovative technology?

Treatment of contaminated sludges and soils is a field of technology that has developed and grown since Congress passed the "Superfund" law for contaminated waste site cleanup in 1980. An initial approach to eliminate a hazardous waste from a particular location was to move it somewhere else, or cover it with a cap. These methods

use *land disposal* as the solution to the problem. With an increasing number of cleanups underway, and the passage of amendments to the Superfund law in 1986 that stated a preference for *treatment*, demand developed for alternatives to land disposal that provided more permanent and less costly solutions for dealing with contaminated materials. Development and use of more suitable treatment technologies has progressed.

As knowledge about the cleanup of contaminated sites increases, new methods for more effective, permanent cleanups will become available. Innovative treatment technologies, which lack a long history of full-scale use, do not have the extensive documentation necessary to make them a standard choice in the engineering/scientific community. However, many innovative technologies have been used successfully at contaminated sites in the United States, Canada, and Europe despite incomplete verification of their utility. Some of the technologies were developed in response to hazardous waste problems and some have been adapted from other industrial uses.

Developing and perfecting treatment technologies is an on-going process, as shown in Figure 1 on page 2. The process begins with a **concept** — an idea of how to treat a particular hazardous waste. The concept usually undergoes a research and evaluation process to prove its feasibility. If the concept is found to be useful, often the next step is to undergo bench-scale testing. During bench-scale testing, a small-scale version of the technology is

Why Use Innovative Treatment Technologies?

- They offer cost-effective, long-term solutions to hazardous waste clean-up problems.
- They provide alternatives to land disposal or incineration.
- They are often more acceptable to surrounding communities than some established treatment technologies.

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Appendix V: A Citizen's Guide to Innovative Treatment Technologies (cont.)

Are Innovative Treatment Technologies Always the Right Choice?

Although innovative treatment technologies may be less expensive and even more effective than established technologies, science and engineering professionals must determine which technology is most appropriate at a given site.

built and tested in a laboratory. During this testing, it is considered an **emerging** technology. If it is successful during bench-scale testing, it is then demonstrated at small-scale levels at field sites. If successful at the field demonstrations, the technology often will be used full-scale at contaminated waste sites. As the technology is used and evaluated at different sites, it is continuously improved.

Only after a technology has been used at many different types of sites and the results fully documented, is it considered an **established** technology. The majority of technologies in use today are still classified as **innovative**.

What types of treatment technologies are in use?

Established technologies such as incineration and solidification/stabilization have been the most widely used at Superfund sites. By 1990, however, 40 percent of the treatment technologies used were innovative. In 1994 the figure reached almost 60 percent. Table 1 on page 3 describes some of the most frequently used innovative treatment technologies.

How is a treatment technology selected for a site?

Before a treatment technology can be selected for a Superfund site, detailed information about the site conditions and contaminants must be collected. EPA uses this information to determine which of the possible remedies will be capable of meeting the clean-up standards that EPA has set.

A treatability study is often conducted to assess a treatment technology's potential for success. It is conducted on contaminated material from the site, either when the treatment technology is being considered or after selection of the remedy, in order to collect additional operation and performance information.

There are three levels of a treatability study. The level chosen depends on the information available about the site and technology and the nature of information that is needed. The quickest, least expensive treatability study is the **laboratory screening**. It is done to learn more about the characteristics of the waste to determine if it would be treatable by a particular technology. A laboratory screening test takes a matter of days and generally costs from \$10,000 to \$50,000. Successful laboratory screening may lead to more sophisticated treatability studies.

The next level of a treatability study is the **bench-scale study** which provides greater information on the performance (and, in some cases, the cost) of a technology by simulating the treatment process using a very small quantity of waste. The objective of this type of test is to determine if the technology can meet the clean-up standards set for the site. These tests typically cost between \$50,000 and \$250,000.

At the highest level, the **pilot-scale treatability study** is usually conducted in the field or the laboratory and requires installation of the treatment technology. This study is used to provide performance, cost, and design objectives for the treatment technology. Due to the cost of this type of study—generally more than \$250,000—it is used almost exclusively to fine-tune the design of the technology following other treatability studies.

What happens if a technology does not work?

There is always a possibility that a treatment technology, established or innovative, may not work once it is in full-scale operation in spite of the best engineering design. Site conditions that could not be predicted from the smaller-scale studies are often to blame. Natural conditions are far more complex than laboratory conditions.

Figure 1
Developing Treatment Technologies

Concept	Emerging	Innovative	Established
<ul style="list-style-type: none"> • Idea • Research • Laboratory Screening 	<ul style="list-style-type: none"> • Bench-Scale Study 	<ul style="list-style-type: none"> • Pilot-Scale Study or Field Demonstration • Chosen for Cleanup • Limited Full-Scale Use 	<ul style="list-style-type: none"> • Common Full-Scale Use

Appendix V: A Citizen's Guide to Innovative Treatment Technologies (cont.)

Table 1
Descriptions of Some Innovative Treatment Technologies

Soil Vapor Extraction removes contaminant vapors from soil (without having to dig it up) through the use of vacuum extraction wells placed in the ground. Contaminants are collected for further treatment.

Air Sparging injects air into the ground below the contaminated area, forming bubbles that rise and carry trapped and dissolved contaminants to the surface where they are captured by a soil vapor extraction system.

Bioremediation uses microorganisms, such as bacteria in engineered processes, to break down organic contaminants into harmless substances.

Thermal Desorption heats soil at relatively low temperatures to vaporize contaminants with low boiling points. Vaporized contaminants then are captured and removed for further treatment or destruction.

Soil Washing uses water or a washing solution and mechanical processes to scrub excavated soils and remove hazardous contaminants.

Chemical Dehalogenation converts contaminants that contain halogens (chlorine and fluorine, for example) to less toxic substances through controlled chemical reactions that remove or replace halogen atoms.

Solvent Extraction separates hazardous organic contaminants from oily-type wastes, soils, sludges, and sediments, reducing the volume of hazardous waste that must be treated.

In Situ Soil Flushing floods contaminated soils beneath the ground surface with a solution that flushes the contaminants to an area where they can be extracted.

A technology may be adapted or redesigned to treat targeted waste, despite initial failures. In some rare cases a different technology may have to be designed and installed. Experience with and increasing use of innovative treatment technologies will lead to better and faster ways to clean up the environment.

Where are innovative treatment technologies being selected?

Industry is using technologies labeled as "innovative" by EPA for containing and treating the hazardous wastes generated during manufacturing processes. Innovative technologies also are being used under many federal and state clean-up programs to treat hazardous wastes that have been improperly released on the land. For example, innovative technologies are being selected to manage contamination (primarily petroleum) at some leaking underground tank sites. They also are being selected to clean up contamination that resulted from past disposal practices at industrial sites regulated under the Resource Conservation and Recovery Act, and to clean up contamination at uncontrolled hazardous wastes sites, known as Superfund sites. One innovative treatment technology, soil vapor extraction, is now routinely used in federal and state clean-up programs. As more cost and

performance data are documented, innovative treatment technologies will be increasingly recognized for their effectiveness.

Why is EPA encouraging the use of innovative treatment technologies?

The Environmental Protection Agency is encouraging the selection of innovative treatment technologies for site remedies because they have the potential to be more cost-effective and to provide better and more efficient cleanups. In addition, they are often more acceptable to surrounding communities than established treatment technologies.

Appendix V: A Citizen's Guide to Innovative Treatment Technologies (cont.)

EPA Supports the Use of Innovative Treatment Technologies

The mission of EPA's Technology Innovation Office (TIO) is to increase government and industry use of innovative treatment technologies at contaminated waste sites.

Numerous other efforts to increase the use of innovative technologies are described in the EPA fact sheet entitled *Progress in Reducing Impediments to the Use of Innovative Remediation Technology*. (The document number is EPA 542-F-95-008 and can be ordered from NCEPI at the address given below.)

For More Information

The U.S. EPA's Technology Innovation Office has produced a series of Citizen's Guides, including this one, on topics relating to innovative treatment technologies:

- *A Citizen's Guide to Soil Washing*, EPA 542-F-96-002
- *A Citizen's Guide to Solvent Extraction*, EPA 542-F-96-003
- *A Citizen's Guide to Chemical Dehalogenation*, EPA 542-F-96-004
- *A Citizen's Guide to Thermal Desorption*, EPA 542-F-96-005
- *A Citizen's Guide to In Situ Soil Flushing*, EPA 542-F-96-006
- *A Citizen's Guide to Bioremediation*, EPA 542-F-96-007
- *A Citizen's Guide to Soil Vapor Extraction and Air Sparging*, EPA 542-F-96-008
- *A Citizen's Guide to Phytoremediation*, EPA 542-F-96-014
- *A Citizen's Guide to Natural Attenuation*, EPA 542-F-96-015
- *A Citizen's Guide to Treatment Walls*, EPA 542-F-96-016

Some other publications of interest include:

- *Selected Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation: A Bibliography of EPA Resources*, EPA 542-B-95-001. A bibliography of EPA publications about innovative treatment technologies.
- *Innovative Treatment Technologies: Annual Status Report (7th Ed.)*, EPA 542-R-95-008. A description of sites at which innovative treatment technologies have been used or selected for use.
- *Innovative Treatment Technologies: Annual Status Report Database*. An automated computer database of descriptions of sites at which innovative treatment technologies have been used or selected for use. The database can be downloaded free of charge from EPA's Cleanup Information bulletin board (CLU-IN). Call CLU-IN at 301-589-8366 (modem). CLU-IN's help line is 301-589-8368. The database also is available for purchase on diskettes. Contact NCEPI for details.

Copies of the items listed above are available from:

National Center for Environmental Publications and Information (NCEPI)
P.O. Box 42419
Cincinnati, OH 45242
Fax your order request to 513-489-8695 or call 513-489-8190

If these documents are out of stock, you may be directed to other sources. In this case, there may be a charge for some of these documents.

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Appendix VI: Commonly Used Institutional Controls

This appendix provides a brief description of seven types of institutional controls that have been commonly used. This is not an exhaustive list of all possible institutional controls.

I. Deed Restrictions

Deed restrictions place limits and conditions on the use and conveyance of land. They serve two purposes: informing prospective owners and tenants of the environmental status of the property and ensuring long-term compliance with the institutional controls that are necessary to maintain the integrity of the remedial action over time.

Typically, there are four requirements for a promise in a deed restriction (also called a "restrictive covenant") to be held against current and subsequent landowners.

- The conveyance of land must be documented in writing.
- The deed restriction should precisely reflect what the parties' intentions are in regard to the scope and the duration of the restrictions.
- There should be "privity of estate" so that states may enforce a deed restriction.
- The promise "touches and concerns the land."

II. Use Restrictions

Use restrictions are usually the heart of what is in a deed restriction. Use restrictions describe appropriate and inappropriate uses of the property, in an effort to perpetuate the benefits of the remedial action and ensure property use that is consistent with the applicable clean-up standard. Such techniques also prohibit any person from making any use of the site in a manner that creates an unacceptable risk of human or environmental exposure to the residual contamination.

Use restrictions address uses that may disturb a containment cap or any unremediated soils under the surface or below a building. A prohibition on drinking on-site (or off-site by means of well restriction areas discussed below) ground water may also be appropriate. As an example, a program may allow a restriction of record to include one or more of the following:

- Restricting property use;
- Conditioning the change of use from nonresidential to residential on compliance with all applicable clean-up standards for a residential property;
- Restricting access; or
- Restricting disturbance of department-approved remedial effects.

Well restriction areas can be a form of institutional control by providing notice of the existence of contaminants in ground water and by prohibiting or conditioning the placement and use of any or all types of wells within the area.

III. Access Controls

Another subset of institutional controls is the control of access to any particular site. Access can be controlled by either fencing and gates, security, posting or warnings. A state may use

Appendix VI: Commonly Used Institutional Controls (cont.)

the following criteria to determine the appropriate level and means of access control:

- Whether the site is located in a residential or mixed-use neighborhood;
- Proximity to sensitive land-use areas including day care centers, playgrounds, and schools; and
- Whether the site is frequently traversed by neighbors.

IV. Notice

Regulations of this type generally provide notice of specific location of contamination on the site and disclose any restrictions on access, use, and development of part or all of the contaminated site to preserve the integrity of the remedial action. The three types of notices that are described in this appendix are record notice, actual notice, and notice to government authorities.

A. Record Notice

Some states require that sites having releases of hazardous waste file a notice on the land records providing to any subsequent purchaser of the property information regarding the past or current activities on the site. The record notice may be broad; the program may require any property subject to a response action to obtain a professional opinion and then prepare and record a Grant of Environmental Restriction that is supported by that opinion. The record notice can be ancillary to a transfer act, in which case recording of an environmental statement is only required in conjunction with a land transaction.

B. Actual Notice

States may require direct notice of environmental information to other parties to a land transaction. These laws protect potential buyers and tenants, and they also help ensure that use restrictions and other institutional controls are perpetuated. Actual notice of an environmental defect or failure to provide notice may give a party the right to cancel the transaction and may result in civil damages.

C. Notice to Government Authorities

Parties to a land transaction may also be required to file the environmental statement with various environmental authorities. Notice to the government may be required before the transaction takes place.

V. Registry Act Requirements

Some states have registry act programs that provide for the maintenance of a registry of hazardous waste disposal sites and the restriction of the use and transfer of listed sites. The registry includes the location of the site and a listing of the hazardous wastes on the property and may also include a classification of the level of health or environmental danger presented by the conditions on the property. When a site appears on the state registry, the owner must comply with regulatory requirements in regard to use and transfer of the site. The use of a site listed on the

Appendix VI: Commonly Used Institutional Controls (cont.)

registry may not be changed without permission of the state agency. (This list of registry act programs has been included only as an illustrative example of institutional controls.)

VI. Transfer Act Requirements

Some states have transfer act programs that require full evaluation of all environmental issues before or after the transfer occurs. It may be that, within such a program, institutional controls can be established by way of consent order, administrative order, or some other technique that establishes implementation and continued responsibility for institutional controls. A typical transfer act imposes obligations and confers rights on parties to a land transaction arising out of the environmental status of the property to be conveyed. Transfer acts impose information obligations on the seller or lessor of a property. That party must disclose general information about strict liability for clean-up costs as well as property-specific information, such as presence of hazardous substances, permitting requirements and status, releases, and enforcement actions and variances.

VII. Contractual Obligations

One system for ensuring the future restriction on use of a site, or the obligation to remediate a site, is to require private parties to restrict use by contract. While this method is often negotiated among private parties, it will be difficult, if not impossible, to institutionalize some control over that process without interfering with the abilities and rights of private parties to freely negotiate these liabilities. Another avenue is for the landowner or responsible party to obligate itself to the state by contract. The state may require a contractual commitment from the party to provide long-term monitoring of the site, use restrictions, and means of continued funding for remediation.

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PERFORMING CLOSURE AND POST-CLOSURE CARE
APPENDICES

Appendix I: Example Closure and Post-Closure Estimate Form*

(All Costs Shown in (\$000))

Provisions	Total Closure Costs Yrs. (-)	Total Post-Closure Costs Yrs. (-)	Total Closure/Post Closure Costs (-)
i. Soil Erosion and Sediment Control Plan		NA	
ii. Final Cover		NA	
iii. Final Cover Vegetation		NA	
iv. Maintenance Program for Final Cover and Final Cover Vegetation	NA		
v. Maintenance Program for Side Slopes	NA		
vi. Run-On and Run-off Control Program		NA	
vii. Maintenance Program for Run-On and Run-off Control System	NA		
viii. Ground-water Monitoring Wells		NA	
ix. Maintenance Program for Ground-water Monitoring Wells	NA		
x. Ground-water Monitoring	NA		
xi. Methane Gas Venting or Evacuation System		NA	
xii. Maintenance Program for Methane Gas Venting or Evacuation System	NA		
xiii. Leachate Collection and/or Control System		NA	
xiv. Maintenance Program for Leachate Collection and/or Control System	NA		
xv. Facility Access Control System		NA	
xvi. Maintenance Program for Facility Access Control System	NA		
xvii. Measures to Conform the Site to Surrounding Area		NA	
xviii. Maintenance Program for Site Conformance Measures	NA		
xix. Construction Quality Assurance and Quality Control		NA	

TOTAL COSTS

*Developed from New Jersey Department of Environmental Protection, Bureau of Landfill Engineering Landfill Permits

Appendix I: Example Closure and Post-Closure Estimate Form (All Costs Shown in (\$000) (cont.)

Provisions	Total Post-Closure Costs	Year #1	Year #2	Year #3	Year #4	Year #5	Year #6	Year #7
i. Soil Erosion and Sediment Control Plan	NA							
ii. Final Cover	NA							
iii. Final Cover Vegetation	NA							
iv. Maintenance Program for Final Cover and Final Cover Vegetation								
v. Maintenance Program for Side Slopes								
vi. Run-On and Run-off Control Program	NA							
vii. Maintenance Program for Run-On and Run-off Control System								
viii. Ground-water Monitoring Wells	NA							
ix. Maintenance Program for Ground-water Monitoring Wells								
x. Ground-water Monitoring								
xi. Methane Gas Venting or Evacuation System	NA							
xii. Maintenance Program for Methane Gas Venting or Evacuation System								
xiii. Leachate Collection and/or Control System	NA							
xiv. Maintenance Program for Leachate Collection and/or Control System								
xv. Facility Access Control System	NA							
xvi. Maintenance Program for Facility Access Control System								
xvii. Measures to Conform the Site to Surrounding Area	NA							
xviii. Maintenance Program for Site Conformance Measures								
xix. Construction Quality Assurance and Quality Control	NA							

TOTAL COSTS

Appendix II: Sample Cost Estimating Worksheets*

LANDFILLS**LF-1****INVENTORY - Page 1 of 1**

The inventory worksheet will be used in completing the appropriate cost estimating worksheets to determine the cost of closure activities. If the design characteristics of the landfill or unit being closed do not conform to the format of the worksheet below, alternative methods should be used to accurately determine the area of the landfill or unit being closed, and the volume of materials being used to construct the final cover.

1 AREA OF LANDFILL			
Calculate the area of the landfill to determine the cost of constructing a final cover.			
1.A	Length	ft	
1.B	Width	ft	
1.C	Area of Landfill (Multiply line 1.A by line 1.B)	ft ²	
1.D	Area in yd ² (Divide line 1.C by 9 ft ² /yd ²)		yd ²
2 VOLUME OF CLAY LAYER			
2.A	Thickness of clay layer	ft	
2.B	Volume of Clay Layer (Multiply line 1.C by line 2.A)	ft ³	
2.C	Volume of Clay Layer in yd ³ (Divide line 2.B by 27 ft ³ /yd ³)		yd ³
3 VOLUME OF SAND OR GRAVEL			
3.A	Thickness of sand or gravel layer	ft	
3.B	Volume of Sand or Gravel Layer (Multiply line 1.C by line 3.A)	ft ³	
3.C	Volume of Sand or Gravel Layer in yd ³ (Divide line 3.B by 27 ft ³ /yd ³)		yd ³
4 VOLUME OF TOPSOIL LAYER			
4.A	Thickness of topsoil	ft	
4.B	Volume of Topsoil Layer (Multiply line 1.C by line 4.A)	ft ³	
4.C	Volume of Topsoil Layer in yd ³ (Divide line 4.B by 27 ft ³ /yd ³)		yd ³

*Worksheets generated from CostPro®: Closure and Post-Closure Cost Estimating Software, available from Steve Jeffords of Tetra Tech EM Inc., 404 225-5514, or 285 Peach Tree Center Avenue, Suite 900, Atlanta, GA, 30303.

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-2**

Facility Name: _____

SUMMARY WORKSHEET			
Activity		Worksheet Number	Cost
Some of the activities listed below are routine. The owner or operator might elect or be required to conduct additional activities. <i>Italic type denotes worksheets for estimating the costs of those additional activities.</i>			
1.	Installation of Clay Layer	LF-3	\$
2.	Installation of Geomembrane	LF-4	\$
3.	Installation of Drainage Layer	LF-5	\$
4.	Installation of Topsoil	LF-6	\$
5.	Establishment of Vegetative Cover	LF-7	\$
6.	<i>Installation of Colloid Clay Liner</i>	LF-8	\$
7.	<i>Installation of Asphalt Cover</i>	LF-9	\$
8.	<i>Decontamination^a</i>	DC-1	\$
9.	<i>Sampling and Analysis^b</i>	SA-2	\$
10.	<i>Monitoring Well Installation^c</i>	MW-1	\$
11.	<i>Transportation^d</i>	TR-1	\$
12.	<i>Treatment and Disposal^e</i>	TD-1	\$
13.	Subtotal of Closure Costs (Add lines 1 through 12)		\$
14.	Engineering Expenses (Engineering expenses are typically 10% of closure costs, excluding survey plat, certification of closure, and post-closure care.)		\$
15.	Survey Plat	LF-10	\$
16.	Certification of Closure	LF-11	\$
17.	Subtotal (Add engineering expenses and cost of the survey plat, certification of closure, and post-closure care to closure costs (Add lines 12 through 16))		\$
18.	Contingency Allowance (Contingency allowances are typically 20% of closure costs, engineering expenses, cost of survey plat, cost of certification of closure, and post-closure care.)		\$
19.	Post-Closure Care ^f	PC-1	\$
TOTAL COST OF CLOSURE (Add lines 17, 18 and 19)			\$

Notes:

- ^a Decontamination Worksheets are found in Chapter 12.
- ^b Sampling and Analysis Worksheets are found in Chapter 13.
- ^c Monitoring Well Installation Worksheets are found in Chapter 14.
- ^d Transportation Worksheets are found in Chapter 15.
- ^e Treatment and Disposal Worksheets are found in Chapter 16.
- ^f Post-Closure Care Worksheets are found in Chapter 17.

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-3****INSTALLATION OF CLAY LAYER - Page 1 of 2**

1 PURCHASE AND DELIVERY OF CLAY			
1.A	Volume of clay required (Enter from worksheet LF-1, line 2.C)	yd ³	
1.B	Compaction factor (use 0.40 if unknown)		
1.C	Volume of additional clay required (Multiply line 1.A by line 1.B)	yd ³	
1.D	Total volume of clay required (Add lines 1.A and 1.C) (One yd ³ minimum; round up to the nearest whole number)	yd ³	
1.E	Cost of clay per yd ³	\$ /yd ³	
1.F	Subtotal of cost of clay (Multiply line 1.D by line 1.E)		\$
1.G	Cost of delivery of clay per yd ³	\$ /yd ³	
1.H	Subtotal of cost to deliver clay (Multiply line 1.D by line 1.G)		\$
1.I	Cost to Purchase and Deliver Clay (Add lines 1.F and 1.H)		\$
2 SPREADING AND COMPACTING CLAY LAYER			
2.A	Labor and equipment cost per work hour Choose the appropriate level of PPE: a. Protection Level D \$ ____/work hr b. Protection Level C \$ ____/work hr c. Protection Level B \$ ____/work hr	\$	
2.B	Work rate required to spread one yd ³ of clay	work hr/yd ³	
2.C	Number of hours required to spread clay (Multiply line 1.D by line 2.B) (One-hour minimum; round up to the 0.5 hour)	work hrs	
2.D	Subtotal of labor and equipment costs to spread clay (Multiply line 2.A by line 2.C)		\$
2.E	Labor and equipment cost per work hour Choose the appropriate level of PPE: a. Protection Level D \$ ____/work hr b. Protection Level C \$ ____/work hr c. Protection Level B \$ ____/work hr	\$	
2.F	Work rate required to compact one yd ³ of clay	work hr/yd ³	

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-3****INSTALLATION OF CLAY LAYER - Page 2 of 2**

2.G	Number of hours required to compact clay (Multiply line 1.D by line 2.F) (One hour minimum; round up to the 0.5 hour)	work hrs	
2.H	Subtotal of labor and equipment costs to compact clay (Multiply line 2.E by line 2.G)		\$
2.I	Cost of mobilization and demobilization		\$
2.J	Cost to Spread and Compact Clay Layer (Add lines 2.D, 2.H, and 2.I)		\$
3 TESTING OF CLAY LAYER			
For cost estimation, clay testing should be completed for every 12,000 ft ² of area for each lift or 6-inch layer. Assume that it takes 6 lifts to construct a compacted two-foot clay layer. During installation of the clay layer, the properties of the clay being placed must be tested to assure that the clay layer meets specific engineering requirements. Each clay lift must be tested for liquid limits, plasticity index, moisture content, in-place density, reconstituted permeability, and a gradation analysis.			
3.A	Area of landfill (Enter from landfill inventory worksheet, line 1.C)	ft ²	
3.B	Number of tests per clay lift (Divide line 3.A by 12,000 ft ² and round up to the nearest whole number)	tests	
3.C	Total number of tests required (Multiply line 3.B by 6 lifts)	tests	
3.D	Cost per set of tests	\$	
3.E	Cost to Perform Tests (Multiply line 3.C by line 3.D)		\$
TOTAL COST OF INSTALLATION OF CLAY LAYER (Add lines 1.I, 2.J, and 3.E) (Enter total on worksheet LF-2, line 1)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS

LF-4

INSTALLATION OF GEOMEMBRANE - Page 1 of 1

1	Area of landfill (Enter from worksheet LF-2, line 1.C)	ft ²	
2	Cost to install geomembrane liner per ft ²	\$ /ft ²	
3	Subtotal to install geomembrane liner (Multiply line 1 by line 2)	\$	
4	Cost of engineering controls, inspection, and testing (Multiply line 3 by 0.25)	\$	
TOTAL COST OF INSTALLATION OF GEOMEMBRANE (Add lines 3 and 4) (Enter total on worksheet LF-2, line 2)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-5****INSTALLATION OF DRAINAGE LAYER - Page 1 of 2**

1 PURCHASE AND DELIVERY OF SAND OR GRAVEL			
1.A	Volume of sand or gravel required (Enter from worksheet LF-1, line 3.C)	yd ³	
1.B	Compaction factor (use 0.075 if unknown)		
1.C	Volume of additional sand or gravel required (Multiply line 1.A by line 1.B)	yd ³	
1.D	Total volume of sand or gravel required (Add lines 1.A and 1.C)	yd ³	
1.E	Cost of sand or gravel per yd ³	\$ /yd ³	
1.F	Subtotal of cost to purchase sand or gravel (Multiply line 1.D by line 1.E)		\$
1.G	Cost of delivery of sand or gravel per yd ³	\$ /yd ³	
1.H	Subtotal of cost to deliver sand or gravel (Multiply line 1.D by line 1.G)		\$
1.I	Cost to Purchase and Deliver Sand or Gravel (Add lines 1.F and 1.H)		\$
2 SPREADING AND COMPACTING SAND OR GRAVEL LAYER			
2.A	Labor and equipment per yd ³	\$ /yd ³	
2.B	Subtotal of labor and equipment costs to spread sand or gravel (Multiply line 1.D by line 2.A)		\$
2.C	Labor and equipment per yd ³	\$ /yd ³	
2.D	Subtotal of labor and equipment costs to compact sand or gravel (Multiply line 1.D by line 2.C)		\$
2.E	Cost of mobilization and demobilization		\$
2.F	Cost to Spread and Compact Sand or Gravel Layer (Add lines 2.B, 2.D, and 2.E)		\$
3 PURCHASE, DELIVERY, AND INSTALLATION OF GEOTEXTILE FILTER FABRIC			
3.A	Area of landfill (Enter from worksheet LF-1, line 1.D)	yd ²	
3.B	Cost of geotextile filter fabric per yd ²	\$ /yd ²	
3.C	Cost to Purchase, Deliver, and Install Geotextile Filter Fabric (Multiply line 3.A by line 3.B)		\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS

LF-5

INSTALLATION OF DRAINAGE LAYER - Page 2 of 2

4.A	Length of landfill (Enter from worksheet LF-2, line 1.A)	ft	
4.B	Width of landfill (Enter from worksheet LF-1, line 1.B)	ft	
4.C	Length of drainage pipe needed (Add lines 4.A and 4.B and multiply total by 2)	ft	
4.D	Cost of drainage pipe per ft	\$ /ft	
4.E	Cost to Purchase and Install Drainage Piping (Multiply line 4.C by line 4.D)	\$	
TOTAL COST OF INSTALLATION OF DRAINAGE LAYER (Add lines 1.I, 2.F, 3.C, and 4.E) (Enter total on worksheet LF-2, line 3)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-6****INSTALLATION OF TOPSOIL - Page 1 of 1**

1 PURCHASE AND DELIVERY OF TOPSOIL			
1.A	Volume of topsoil required (Enter from worksheet LF-1, line 4.C)	yd ³	
1.B	Compaction factor (use 0.25 if unknown)		
1.C	Volume of additional topsoil required (Multiply line 1.A by line 1.B)	yd ³	
1.D	Total volume of topsoil required (Add lines 1.A and 1.C) (One yd ³ minimum; round up to the nearest whole number)	yd ³	
1.E	Cost of topsoil per yd ³	\$ /yd ³	
1.F	Subtotal of cost to purchase topsoil (Multiply line 1.D by line 1.E)		\$
1.G	Cost of delivery of topsoil per yd ³	\$ /yd ³	
1.H	Subtotal of cost to deliver topsoil (Multiply line 1.D by line 1.G)		\$
1.I	Cost to Purchase and Deliver Topsoil (Add lines 1.F and 1.H)		\$
2 SPREADING AND COMPACTING TOPSOIL LAYER			
2.A	Labor and equipment cost per yd ³	\$ /yd ³	
2.B	Subtotal of labor and equipment costs to spread topsoil (Multiply line 1.D by line 2.A)		\$
2.C	Labor and equipment cost per yd ³ to compact topsoil	\$ /yd ³	
2.D	Subtotal of labor and equipment costs to compact topsoil (Multiply line 1.D by line 2.C)		\$
2.E	Cost of mobilization and demobilization		\$
2.F	Cost to Spread and Compact Topsoil (Add lines 2.B, 2.D, and 2.E)		\$
TOTAL COST OF INSTALLATION OF TOPSOIL (Add lines 1.I and line 2.F) (Enter total on worksheet LF-2, line 4)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-7****ESTABLISHMENT OF VEGETATIVE COVER - Page 1 of 1**

1 SOIL PREPARATION			
1.A	Area of landfill (Enter from worksheet LF-1, line 1.C)	ft ²	
1.B	Convert area in ft ² to area in thousand square feet (MSF) (Divide line 1.A by 1,000 ft ² /MSF)	MSF	
1.C	Labor and equipment cost per MSF	\$ /MSF	
1.D	Cost of mobilization and demobilization		\$
1.F	Cost to Prepare Soil (Multiply line 1.B by line 1.C and add line 1.D)		\$
2 SEEDING, FERTILIZING, AND MULCHING			
2.A	Labor, material and equipment cost per MSF	\$ /MSF	
2.B	Cost of mobilization and demobilization		\$
2.C	Cost to Seed, Fertilize, and Mulch (Multiply line 1.B by line 2.A and add line 2.B)		\$
TOTAL COST OF ESTABLISHMENT OF VEGETATIVE COVER (Add lines 1.F and 2.C) (Enter total on worksheet LF-2, line 5)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-8****INSTALLATION OF COLLOID CLAY LINER - Page 1 of 1**

A colloid clay liner is an alternative to the traditional composite clay liner. Complete this worksheet only if the owner's or operator's closure plan specifies the use of a colloid clay liner as a substitute for a portion of the clay liner.

1	Area of landfill (Enter from worksheet LF-1, line 1.C)	ft ²	
2	Cost of installing colloid clay liner per ft ²	\$ /ft ²	
TOTAL COST OF INSTALLATION OF COLLOID LINER (Multiply line 1 by line 2) (Enter total on worksheet LF-2, line 6)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS

LF-9

INSTALLATION OF ASPHALT COVER - Page 1 of 1

Complete this worksheet only if the cover material is specified to be asphalt. For an asphalt cover, costs for installing topsoil and a vegetative cover will not be incurred and should not be estimated.

1	Area of landfill (Enter from worksheet LF-1, line 1.D)	ft ²	
2	Cost of installing asphaltic concrete pavement. Includes binder course and wearing course	\$ /ft ²	
3	Subtotal of cost to install pavement (Multiply line 1 by line 2)	\$	
4	Cost of engineering controls, inspection, and testing (Multiply line 3 by 0.25)	\$	
TOTAL COST OF INSTALLATION OF ASPHALT COVER (Add lines 3 and line 4) (Enter total on worksheet LF-2, line 7)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-2****REMOVAL OF LEACHATE - Page 1 of 1**

1	Volume of leachate to be removed per removal event	gal	
2	Number of leachate removal events per year	events/year	
3	Volume of leachate to be removed per year (Multiply line 1 by line 2)	gal/year	
4	Removal cost of leachate per year (Multiply line 3 by \$ ____ per gallon)	\$ /year	
5	Number of years in the post-closure care period ^a	years	
TOTAL COST OF REMOVAL OF LEACHATE (Multiply line 4 by line 5) (Enter total on Worksheet PC-1, line 1)			\$

Notes:

- ^a Assume 30 years of post-closure care, unless otherwise specified by the owner or operator.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE

PC-2

REMOVAL OF LEACHATE - Page 1 of 1

1	Volume of leachate to be removed per removal event	gal	
2	Number of leachate removal events per year	events/year	
3	Volume of leachate to be removed per year (Multiply line 1 by line 2)	gal/year	
4	Removal cost of leachate per year (Multiply line 3 by \$ ____ per gallon)	\$ /year	
5	Number of years in the post-closure care period ^a	years	
TOTAL COST OF REMOVAL OF LEACHATE (Multiply line 4 by line 5) (Enter total on Worksheet PC-1, line 1)			\$

Notes:

- ^a Assume 30 years of post-closure care, unless otherwise specified by the owner or operator.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-3****SITE SECURITY - Page 1 of 1**

1 FENCING			
1.A	Length of fencing*	ft	
1.B	Labor, material, and equipment cost per ft	\$ /ft	
1.C	Cost to Fence Site (Multiply line 1.A by line 1.B)		\$
2 CORNER POSTS			
2.A	Number of corner posts required (if unknown, assume four)	posts	
2.B	Cost per corner post	\$ /post	
2.C	Cost to Erect Corner Posts (Multiply line 2.A by line 2.B)		\$
3 GATES			
3.A	Number of gates required (Assume minimum of one unless otherwise specified)	gate(s)	
3.B	Labor, materials, and equipment cost per gate	\$ /gate	
3.C	Cost to Install Gates (Multiply line 3.A by line 3.B)		\$
4 REFLECTOR SIGNS			
4.A	Number of signs required (Assume a minimum of four, unless otherwise specified)	/sign	
4.B	Labor, materials, and equipment cost per sign	\$ /sign	
4.C	Total Cost to Install Signs (Multiply line 4.A by line 4.B)		\$
TOTAL COST OF SITE SECURITY (Add lines 1.C, 2.C, 3.C, and 4.C) (Enter total on worksheet PC-1, line 2)			\$

Notes:

- ^a Determine the total length of fencing required by adding the lengths of all sides of the unit and multiply the sum by 1.25. The factor of 1.25 allows additional space between the unit and fence for access to the unit.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-4****MAINTENANCE OF VEGETATIVE COVER - Page 1 of 2**

1 MOWING			
1.A	Area of cover to be mowed (Enter from worksheet LF-1, line 1.D)	ft ²	
1.B	Convert the area in ft ² to MSF (thousand square feet) (Divide line 1.A by 1,000)	MSF	
1.C	Labor and equipment cost per MSF	\$ /MSF	
1.D	Cost of one mowing event (Multiply line 1.B by line 1.C)	\$ /event	
1.E	Number of mowing events per year	events/year	
1.F	Number of years in the post-closure care period*	years	
1.G	Number of mowing events during the post-closure care period (Multiply line 1.E by line 1.F)	events	
1.H	Cost to Mow for Post-Closure Care Period (Multiply line 1.D by line 1.G)		\$
2 FERTILIZING			
2.A	Area of cover to be fertilized (Enter from line 1.B)	MSF	
2.B	Labor, material, and equipment cost per MSF	\$ /MSF	
2.C	Cost of one fertilizing event (Multiply line 2.A by line 2.B)	\$ /event	
2.D	Number of fertilizing events per year	events/year	
2.E	Number of years in the post-closure care period*	years	
2.F	Number of fertilizing events during the post-closure care period (Multiply line 2.D by line 2.E)	events	
2.G	Cost to Fertilize for the Post-Closure Care Period (Multiply line 2.C by line 2.F)		\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-4****MAINTENANCE OF VEGETATIVE COVER - Page 2 of 2**

3 WATERING			
3.A	Area of cover to be watered (Enter from line 1.B)	MSF	
3.B	Labor and material cost per MSF	\$ /MSF	
3.C	Cost of one watering event (Multiply line 3.A by line 3.B)	\$ /event	
3.D	Number of watering events per year	events/year	
3.E	Number of years in the post-closure care period	years	
3.F	Number of watering events during the post-closure care period (Multiply line 3.D by line 3.E)	events	
3.G	Cost to Water for the Post-Closure Care Period (Multiply line 3.C by 3.F)	\$	
TOTAL COST OF MAINTENANCE OF VEGETATIVE COVER (Add lines 1.H, 2.G, and 3.G) (Enter total on worksheet PC-1, line 3)			\$

Notes:

- Assume 30 years of post-closure care unless otherwise specified by the owner or operator.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-5****MAINTENANCE AND INSPECTION - Page 1 of 1**

If maintenance costs are not specifically indicated, the cost of maintaining and repairing the final cover can be estimated based on a percentage of the cost of constructing the final cover (such as 20 percent). If the unit is closed and construction costs for the final cover are not available, use landfill worksheets LF-3 through LF-6, found in Chapter 7 to estimate the cost.

1 MAINTENANCE AND REPAIR OF FINAL COVER			
1.A	Cost of installing clay layer (Enter from worksheet LF-2, line 1, or from owner or operator information) ^a	\$	
1.B	Cost of installing geomembrane (Enter from worksheet LF-2, line 2, or from owner or operator information)	\$	
1.C	Cost of installing drainage layer (Enter from worksheet LF-2, line 3, or from owner or operator information)	\$	
1.D	Cost of installing topsoil (Enter from worksheet LF-2, line 4, or from owner or operator information)	\$	
1.E	Total cost of final cover (Add lines 1.A, 1.B, 1.C, and 1.D)	\$	
1.F	Cost to Maintain and Repair Final Cover (Multiply line 1.E by 0.20) ^b	\$	
2 POST-CLOSURE CARE INSPECTION			
2.A	Cost of conducting one inspection	\$ /inspection	
2.B	Number of inspections per year	inspections/year	
2.C	Cost of conducting post-closure care inspections per year (Multiply line 2.A by line 2.B)	\$ /year	
2.D	Number of years in post-closure period	years	
2.E	Cost to Conduct Post-Closure Care Inspections Over the Post-Closure Care Period (Multiply line 2.C by line 2.D)	\$	
TOTAL COST OF MAINTENANCE AND INSPECTION (Add lines 1.F and 2.E) (Enter total on worksheet PC-1, line 4)			\$

Notes:

- ^a The Landfill Summary Worksheet, LF-2, is provided in Chapter 7.
- ^b Unless specified, it is estimated that the cost of maintaining and repairing the final cover during the post-closure care period will be approximately 20 percent of the total cost of installing the final cover.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-6****GROUNDWATER MONITORING - Page 1 of 1**

1	Number of years of groundwater monitoring during the post-closure care period	years	
2	Cost of groundwater monitoring per year ^a	\$ /year	
TOTAL COST OF GROUNDWATER MONITORING (Multiple line 1 by line 2) (Enter on PC-1 worksheet, line 5)			\$

Notes:

- ^a Use worksheet SA-6 in Chapter 13 to determine the yearly cost of sampling and analysis of groundwater during the post-closure care period.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE

PC-7

DEED NOTATION - Page 1 of 1

1	Attorney Fees	\$	
2	Clerical and deed filing fees ^a	\$	
TOTAL COST OF DEED NOTATION (Add lines 1 and 2) (Enter total on worksheet PC-1, line 6)			\$

- ^a The fee for this activity is commonly a percentage of the assessed value of the property, but it can vary according to local statutes.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE**PC-8****MAINTENANCE AND INSPECTION OF ASPHALT COVER - Page 1 of 1**

1 MAINTENANCE OF ASPHALT COVER			
1.A	Area of asphalt cover (Enter from worksheet LF-1, line 1.D, or enter from owner or operator information)	yd ²	
1.B	Cost of sealcoating asphalt cover per yd ²	\$ /yd ²	
1.C	Cost of one sealcoating event (Multiply line 1.A by line 1.B)	\$ /event	
1.D	Number of sealcoating events during the post-closure care period (If not provided, estimate sealcoating will be completed once every five years)	events	
1.E	Total Cost to Maintain Asphalt Cover (Multiply line 1.C by line 1.D)		\$
2 POST-CLOSURE INSPECTION			
2.A	Cost of conducting one inspection	\$ /inspection	
2.B	Number of inspection per year	inspections/year	
2.C	Cost of conducting post-closure care inspections per year	\$ /year	
2.D	Number of years in post-closure*	years	
2.E	Cost to Conduct Post-Closure Inspections Over the Post-Closure Period (Multiply line 2.C by 2.D)		\$
TOTAL COST OF MAINTENANCE AND INSPECTION (Add lines 1.E, and 2.E) (Enter total on worksheet PC-1, line 7)			\$

Notes:

- * Assum 30 years of post-closure care, if not otherwise specified.

Appendix II: Sample Cost Estimating Worksheets (cont.)

POST-CLOSURE CARE

PC-9

CERTIFICATION OF COMPLETION OF POST-CLOSURE CARE - Page 1 of 1

1	Number of units requiring certification of completion of post-closure care		
2	Cost of certification of completion of post-closure care per unit	\$	
TOTAL COST OF CERTIFICATION OF POST-CLOSURE CARE (Multiply line 1 by line 2) (Enter total on worksheet PC-1, line 10)			\$

Appendix II: Sample Cost Estimating Worksheets (cont.)

LANDFILLS**LF-10*****SURVEY PLAT - Page 1 of 1***

1	Area of landfill (Enter from worksheet LF-1, line 1.C)	ft ²	
2	Convert area in ft ² to area in acres (Divide line 1 by 43,560 ft ² /acre)	acres	
3	Labor and materials cost per acre (Minimum charge of one acre)	\$ /acre	
TOTAL COST OF SURVEY PLAT (Multiply line 2 by line 3) (Enter total on worksheet LF-2, line 15)			\$

Appendix II: Sample Cost Estimating Worksheet (cont.)

LANDFILLS

LF-11

CERTIFICATION OF CLOSURE - Page 1 of 1

1	Number of units requiring certification of closure ^a		
2	Cost of certification of closure per unit	\$	
TOTAL COST OF CERTIFICATION OF CLOSURE (Multiply line 1 by line 2) (Enter total on worksheet LF-2, line 16)			\$

Notes:

- ^a Facilities closing a landfill that has multiple cells should include certification of closure in each partial closure cost estimate.

Appendix II: Sample Cost Estimating Worksheets (cont.)

SAMPLING AND ANALYSIS**SA-6****AQUEOUS SAMPLE - Page 1 of 2**

Aqueous samples refer to liquid samples, including samples of rinsate and wastewater. Do not use this worksheet for estimating the cost of sampling other aqueous media, such as groundwater.

1 COLLECTION OF AQUEOUS SAMPLE			
1.A	Number of sampling locations (Enter from worksheet SA-1; line 4)	sample locations	
1.B	Sampling team and equipment cost per work hour ^a Choose the appropriate level of PPE: a. Protection Level D \$ ____/work hr b. Protection Level C \$ ____/work hr c. Protection Level B \$ ____/work hr	\$	
1.C	Work hours required to collect samples from one sampling location	work hr/sample location	
1.D	Number of hours required to collect all samples (Multiply line 1.A by line 1.C)	work hrs	
1.E	Cost to Collect Aqueous Samples (Multiply line 1.B by line 1.D)		
2 ANALYSIS OF AQUEOUS SAMPLE			
2.A	Using the table in the attachment to this worksheet, calculate the cost of analysis per sampling event for aqueous samples (Enter cost from the Attachment to this worksheet)	\$ /event	
2.B	Enter the number of sampling events	events	
2.C	Cost to Analyze Aqueous Samples (Multiply line 2.A by line 2.B)		\$
TOTAL COST OF SAMPLING AND ANALYSIS OF AQUEOUS SAMPLES (Add line 1.E to line 2.C) (Enter total on cost worksheet SA-2, line 4)			\$

Notes:

- ^a Includes cost of collection and handling of samples, vehicle rental, and decontamination of sampling team and sampling equipment.

Appendix II: Sample Cost Estimating Worksheets (cont.)

SAMPLING AND ANALYSIS

SA-6

AQUEOUS SAMPLE ATTACHMENT - Page 2 of 2

Cost of Analysis per Sampling Event
Reference for Line 2.A

Column 1	Column 2	Column 3	Column 4
Analytical Parameter and Method Reference	Cost of Analysis (\$) per Parameter	Number of Analyses, including QC Analyses	Total Cost of Analysis (\$) per Parameter per Event (Multiply Column 2 by Column 3)
TOTAL COST FOR ANALYSIS OF AQUEOUS SAMPLES (Total of all costs in column 4)			\$1,280 /event

Notes:

- a. Identify the number of sampling locations and analyses specified in the work plan or permit. The number of quality control (QC) samples is typically 20 percent of the total number of samples to be analyzed.

Appendix III: Examples of Financial Assurance Mechanisms

- **Trust funds.** A trust fund is an arrangement in which one party, the grantor, transfers cash, liquid assets, certificates of deposit, or government securities into a fund controlled by a special "custodian," the trustee, who manages the money for the benefit of one or more beneficiaries. The trust fund should be dedicated to closure and post-closure care activities. Payments are made annually into the fund so that the full amount for closure and post-closure care accumulates before closure and post-closure care activities start. Place a copy of the trust agreement, which describes how the fund will be used to pay for closure and post-closure care activities, in the waste management unit's operating record.
- **Escrow accounts.** Escrow accounts are similar to trusts in that monies are legally segregated for a specific purpose, such as closure and post-closure care, and are controlled by someone other than the person who pays into the account. An escrow agent, like a trustee, has a fiduciary relationship to both parties in the agreement and must manage the account under terms specified in the escrow agreement. The purpose of an escrow account is to help execute an underlying contract.
- **Surety bonds.** A surety bond guarantees performance of an obligation, such as closure and post-closure care. A surety company is an entity that agrees to answer for the debt or default of another. Payment or performance surety bonds are acceptable in the event an owner or operator fails to conduct closure and post-closure care activities. If you use a surety bond or letter of credit, establish a standby trust fund (essentially the same as a trust fund). In most cases, a standby trust fund is established with an initial nominal fee agreed to by the owner or the operator and the trustee. Further payments into this fund are not required until the standby trust is funded by a surety company. List the surety company as an acceptable surety in Circular 570 of the U.S. Department of Treasury.
- **Letters of credit.** A letter of credit is a formalized line of credit from a bank or another institution on behalf of an owner or operator. This agreement states that it will make available to a beneficiary, such as a state, a specific sum of money during a specific time period. The letter of credit should be irrevocable and issued for 1 year. The letter of credit should also establish a standby trust fund.
- **Insurance.** An insurance policy is basically a contract through which one party guarantees another party monies, usually a prescribed amount, to perform the closure or post-closure care in return for premiums paid. The policy should be issued for a face amount at least equal to the current cost estimate for closure and post-closure care. The face amount refers to the total amount the insurer is obligated to pay; actual payments do not change the face amount.
- **Corporate financial tests.** Corporate financial tests are a method for an owner and operator to self-guarantee that they have the financial resources to pay for closure and post-closure costs. These tests may require that a company meet a specified net worth, a specified ratio of total liabilities to net worth, and a specified net working capital in the United States. Implicit in using a financial test is a reliance on Generally Accepted Accounting Principles (GAAP) to provide fairly represented accounting data. Your financial statements should be audited by an independent certified public accountant. If the accountant gives an adverse opinion or a disclaimer of opinion of the financial statements, use a different financial assurance mechanism.

Appendix III: Examples of Financial Assurance Mechanisms (cont.)

- **Corporate guarantees.** Under a corporate guarantee, a parent company guarantees to pay for closure and post-closure care, if necessary. The parent company should pass a financial test to show that it has adequate financial strength to provide the guarantee. A financial test is a way for guarantors to use financial data to show that their resources are adequate to meet closure and post-closure care costs. The guarantee should only be used by firms with adequate financial strength.
- **Other financial assurance mechanisms.** If you consider other financial assurance mechanisms, talk to your state to see if the mechanism is acceptable.