CROPLAND, PASTURE/HAYLAND

AND ANIMAL WASTE

BEST MANAGEMENT PRACTICES

WYOMING
NONPOINT SOURCE
MANAGEMENT PLAN

Adopted September 29, 2000

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BEST MANAGEMENT PRACTICES

INTRODUCTION

This section addresses the Best Management Practices (BMPs) which are applicable to agricultural cultivated cropland, pasture/ hayland, and animal waste for nonpoint source pollution control. Included are nonpoint source generating activities, such as irrigated and dryland farming, grazing activities, and feedlots. It is recognized that not only do all agricultural activities not result in nonpoint source impairments, but many actually are beneficial in reducing the potential for nonpoint source pollution.

These BMPs have been developed to assist land users to plan and apply treatment measures to solve, reduce, or prevent existing or potential, site specific, nonpoint source water quality impairments.

Nonpoint source pollution, by its nature, tends to be caused by the combined effects from numerous sources (impairments) within a general area rather than from a specific site(s). This is especially true of nonpoint source pollution that may be caused by agricultural uses of land. Surface and groundwater quality may be potentially impacted by agricultural activities.

The primary impairments of concern are (but not limited to) sediment, pesticides, nutrients, salts, heavy metals, and pathogens contained in animal waste. Several impairments occur naturally due to the inherent erodibility of the soils. However, man's activities can increase or decrease the rate of soil erosion and resultant sedimentation of stream beds, as well as lakes and reservoirs.

Nutrients such as phosphorus and nitrates which at times result from agricultural activities may also pose a threat to both surface and groundwater quality. Application of fertilizers and animal wastes to cropland and pasture/ hayland, if improperly applied, may lead to increased nutrient levels in ground and surface waters. Nutrients may also stimulate the growth of algae or nuisance weeds in receiving surface waters. High levels of nitrate (in excess of 10 mg/liter nitrate-nitrogen) in drinking water pose a threat to public health. Recreational activities in lakes, streams, and reservoirs may be restricted if a combination of water temperature and nutrient levels reach a point where cultural eutrophication can occur.

Best Management Practices (BMPs) for nonpoint source water pollution control on cropland, pasture/ hayland, and from animal waste are defined in Wyoming Department of Environmental Quality Rules and Regulations, Chapter 1 as:

> **"Best Management Practices - A practice or combination of practices that after problem assessment, examination of alternative practices and appropriate public participation, are determined to be the most technologically and economically feasible means of preventing or reducing nonpoint source pollution."**

BMPs may include a combination of both structural and nonstructural techniques which either prevent or reduce pollution from nonpoint sources. Attention must also be given to operation and maintenance of the BMPs and replacement of the practices after their useful lives.

The Best Management Practices consist of several conservation practices listed in the USDA Natural Resources Conservation Service's Field Office Technical Guide (FOTG) or similar technical references developed and available from other agencies or sources.

The recommendation of BMPs is a complex issue which requires an understanding of the interaction between various natural resources. The implementation of a BMP at one site may create or increase a nonpoint source problem elsewhere in a watershed, unless it is properly planned and implemented.

In addressing existing or potential nonpoint source impairments, an individual land user; in consultation with personnel from a Conservation District, Cooperative Extension Service, Natural Resources Conservation Service, or equal selects a practice (or combination of practices) that will achieve a desired goal. The land user has the opportunity of combining various structural, vegetative, tillage, cropping sequences, land uses, and management practices that best suit their operation. There are often combinations of practices that will achieve an acceptable level of site specific nonpoint source pollution control and production goals that can be selected by the land user. Key in this planning effort is selection of BMPs to address the identified water quality impairment while assuring the economic viability of the land user. It is noted that this document is open ended and each practice will be periodically reviewed, and if needed revised, to allow for new technology and innovations.

While not normally thought of, included in, or addressed as nonpoint source are toxic organic solvents, oils, and fluids that are used and disposed of "on-farm". Care should be taken, especially near wellheads, in handling and disposal of these toxic organics.

The following pages of this document list, by impairment, applicable practices available for use in applying BMPs for the objective of solving, reducing, or preventing a nonpoint source pollution impairment.

The Natural Resources Conservation Service utilizes the Resource Management Systems (RMS) approach to achieve resource goals on planned lands. An RMS is the correct application of a combination of practices that will result in the sustained use of the resources, and that meet the Quality Criteria for all resources. The NRCS considers all of the resources (soil, water, air, plant, animal, human) during the planning process. The NRCS has identified Essential Practices (similar to Best Management Practices) that when implemented as part of a RMS will achieve the Quality Criteria for the identified land use.

Current copies of the listed NRCS conservation practice standards and specifications are available by contacting any of the following local Natural Resources Conservation Service Offices.

Natural Resources Conservation Service Offices

Natural Resources Conservation Service
P.O. Box 355
Baggs, WY 82321
Phone: (307) 383-2550

Natural Resources Conservation Service
760 West Fetterman
Buffalo, WY 82834
Phone: (307) 684-2526

Natural Resources Conservation Service
2020 Fairgrounds Road, Suite 101
Casper, WY 82604
Phone: (307) 261-5404

Natural Resources Conservation Service
11221 US Highway 30
Cheyenne, WY 82009
Phone: (307) 772-2600

Natural Resources Conservation Service
808 Meadow Lane, Suite A
Cody, WY 82414
Phone: (307) 587-3251

Natural Resources Conservation Service
P.O. Box 98
Cokeville, WY 83114
Phone: (307) 279-3256

Natural Resources Conservation Service
1954 E. Richards - Suite 8
Douglas, WY 82633
Phone: (307) 358-9825

Natural Resources Conservation Service
P.O. Box 27
Dubois, WY 82513
Phone: (307) 455-2388

Natural Resources Conservation Service
P.O. Box 360
Farson, WY 82932
Phone: (307) 273-5531

Natural Resources Conservation Service
P.O. Box 127
Ft. Washakie, WY 82514
Phone: (307) 332-9636

Natural Resources Conservation Service
319 S. Gillette Ave., Suite 310
Gillette, WY 82716
Phone: (307) 682-8842

Natural Resources Conservation Service
408 Greybull Avenue
Greybull, WY 82426
Phone: (307) 765-2483

Natural Resources Conservation Service
P.O. Box 1070
Jackson, WY 83001
Phone: (307) 733-2110

Natural Resources Conservation Service
1460 Main
Lander, WY 82520
Phone: (307) 332-3114

Natural Resources Conservation Service
1050 North 3rd St., Suite B
Laramie, WY 82070
Phone: (307) 745-3698

Natural Resources Conservation Service
359 Nevada Avenue
Lovell, WY 82431
Phone: (307) 548-7422

Natural Resources Conservation Service
P.O. 659
Lusk, WY 82225
Phone: (307) 334-2953

Natural Resources Conservation Service
P.O. Box 370
Lyman, WY 82937
Phone: (307) 787-3794

Natural Resources Conservation Service
1225 Washington Blvd., Suite 3
Newcastle, WY 82701
Phone: (307) 764-3264

Natural Resources Conservation Service
781 Lane 9
Powell, WY 82435
Phone: (307) 754-9301

Natural Resources Conservation Service
P.O. Box 633
Saratoga, WY 82331
Phone: (307) 326-5657

Natural Resources Conservation Service
P.O. Box 1070
Sundance, WY 82729
Phone: (307) 283-2740

Natural Resources Conservation Service
1441 East M St., Suite B
Torrington, WY 82240
Phone: (307) 532-4880

Natural Resources Conservation Service
302 "A" 16th Street
Wheatland, WY 82201
Phone: (307) 322-9060

Natural Resources Conservation Service
208 Shiloh Road
Worland, WY 82401
Phone: (307) 347-2212

Natural Resources Conservation Service
P.O. Box 36
Pinedale, WY 82941
Phone: (307) 367-2257

Natural Resources Conservation Service
320 East Lincoln
Riverton, WY 82501
Phone: (307) 856-7524

Natural Resources Conservation Service
1949 Sugarland Drive
Suite 102
Sheridan, WY 82801
Phone: (307) 672-5820

Natural Resources Conservation Service
318 North 6th
Thermopolis, WY 82443
Phone: (307) 864-3488

Copies of the University of Wyoming materials are generally available at Co-operative Extension Offices in Wyoming or can be obtained by contacting the Agricultural Experiment Station, University of Wyoming, Box 3354, Laramie, Wyoming.

WYOMING
COOPERATIVE EXTENSION SERVICE
COUNTY OFFICES

Albany County Fairgrounds
P.O. Box 1209
Laramie, 82073
721 - 2571

Big Horn County
Courthouse
P.O. Box 601
Basin, 82410
568 - 2281

Campbell County
412 ½ Gillette Ave.
Gillette, 82716
682 - 7281

Carbon County
Carbon Building
P.O. Box 280
Rawlins, 82301
328 - 2642

Converse County
107 North Fifth
Suite 135
Douglas, 82633
358 - 2417

Crook County
Courthouse
P.O. Box 368
Sundance, 82729
283 - 1192

Fremont County
Courthouse
P.O. Box 470
Lander, 82520
332 - 1044

Fremont County
County Complex
P.O. Box 887
Riverton, 82501
857 - 3654

Goshen County
Route 2, Box 373G
Torrington, 82240
532 - 2436

Hot Springs County
328 Arapahoe
Thermopolis, 82443
864 - 3421

Johnson County
762 Fetterman
Buffalo, 82834
684 - 5972

Laramie County
Courthouse
310 W. 19th St. Suite 100
Cheyenne, 82001
633 - 4383

Lincoln County
P.O. Box 309
Afton, 83110
886 - 3132

Lincoln County
925 Sage Ave.
Kemmerer, 83101
877 - 9056

Natrona County
2011 Fairgrounds Rd.
Casper, 82604
235 - 9400

Niobrara County
310 W. HWY. 20
P.O. Box 210
Lusk, 82225
334 - 3534

Park County
P.O. Box 3099
Cody, 82414
527 - 8560

Park County
655 East Fifth St.
Powell, 82435
754 - 5947

Platte County
57 Antelope Gap Rd.
Wheatland, 82201
322 - 3667

Sheridan County
224 S. Main, Suite B10
Sheridan, 82801
674 - 2980

Sublette County
P.O. Box 579
Pinedale, 82941
367 - 4380

Sweetwater County
Western WY CC
P.O. Box 428
Rock Springs, 82901
352 - 6775

Teton County
255 West Deloney
P.O. Box 1708
Jackson, 83001
733 - 3087

Uinta County
228 9th St.
Evanston, 82930
783 - 0570

Washakie County
P.O. Box 609
Worland, 82401
347 - 3431

Weston County
1225 Washington Blvd. Suite 4
Newcastle, 82701
746 - 3531

PRACTICE #1 - BEST MANAGEMENT PRACTICES FOR CONTROLLING OR PREVENTING **SEDIMENT** POLLUTION FROM CROPLAND, PASTURE/ HAYLAND, AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent sediment and other pollutants from entering the surface and groundwaters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, and hayland where soil erosion is occurring, or has the potential of occurring, that will result in excessive sediment loading into surface or groundwaters.

EXPLANATION: Erosion and sediment control measures are only effective when they are properly implemented and maintained. Soil characteristics, soil types, crops grown, production goals, and similar factors, will determine the level of erosion and/or sediment control that can be realized. The Quality Criteria utilized by NRCS when considering the soil resource is to achieve an erosion rate which is considered sustainable. A sustainable erosion rate is that amount of annual soil loss that will not result in long-term soil degradation. Soil erosion from wind is predicted using the Wind Erosion Equation(WEQ-Management Period Method), while soil erosion from water is predicted using the Revised Universal Soil Loss Equation (RUSLE). In addition, soil erosion from concentrated flow such as ephemeral and classic gully, streambank, and irrigation induced erosion are considered. Best Management Practices may be developed to include but are not limited to the practices listed (the number codes listed refer to the USDA Natural Resources Conservation Service's Standard and Specification number or the University of Wyoming's Publication number): Additional information on Best Management Practices to prevent soil erosion are available in publications of the Soil and Water Conservation Society, International Erosion Control Association, and many Agricultural Industry magazines.

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Access Road (560) Conservation Cover (327) Conservation Crop Rotation (328) Conservation Tillage Systems (329) Contour Farming (330) Cover and Green Manure Crop (340) Residue Mgmt Seasonal (344) Dam, Multiple-Purpose (349)[1] Dike (356) Diversion (362) Fence (382) Filter Strip (393) Floodwater Diversion (400) Floodway (404) Grade Stabilization Structure (410) Grassed Waterway (412) Irrigation Canal or Lateral (320) Irrigation Field Ditch (388) Irrigation Land Leveling (464) Irrigation System (441) (442) (443) Irrigation System, Tailwater Recovery (447)[1] Irrigation Water Conveyance (428-A,B,C) (430-AA thru II) Irrigation Water Management (449) Land Smoothing (466) Lined Waterway or Outlet (468) Livestock Exclusion (472) Mulching (484) Open Channel (582) Prescribed Grazing (528) Pasture and Hayland Planting (512) Planned Grazing Systems (556) Pond (378)[1] Pond Sealing or Lining (521)[1] Roof Runoff Management (558) Runoff Management System (570) Sediment Basin (350)[1] Stripcropping, contour (585) Structure for Water Control (587) Subsurface Drain (606)[1] Terrace (600) Water and Sediment Control Basin (638)[1] Well (642)[1]	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (WWRC Pub. # 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP-73.6) Application Uniformity of Sprinkler Irrigation Systems (MP-73.7) Irrigation Water Quantity and Application Time (MP-73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP-73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP-73.10 Irrigation Water Measurement: Irrigation Ditches and Pipelines (B-583R) Management and Monitoring of Grazing on Wyoming's Streamside Zones (B-941) Cover Crops for Wind Erosion Protection of Sugar Beets (B-1052)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Practices should be implemented in accordance with appropriate technical specifications to assure planned erosion and/or sediment control benefits are realized. Advice should be sought from appropriate technical specialists to determine the extent of unnatural erosion, sediment delivery rate, and level of control that may be accomplished. Proximity to surface and groundwater sources should be taken into consideration.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, Wyoming Department of Environmental Quality, University of Wyoming, and private consultants.

REFERENCES: The above numbered standards and specifications, as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and local Conservation Districts. Practice standards and specification may also be available from other federal and state agencies, as well as other sources.

Other technical references include:

(1) NRCS National Engineering Handbook, Issued April 1992, Part 651, Agricultural Waste Management Field Handbook.

PRACTICE #2 - BEST MANAGEMENT-PRACTICES FOR CONTROLLING OR PREVENTING **NUTRIENT** POLLUTION FROM CROPLAND, PASTURE/ HAYLAND, AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent nutrients from entering the surface and groundwaters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, and hayland where nutrients are applied and are causing, or have the potential to cause, excessive nutrient level loading into surface or groundwaters.

EXPLANATION: Depending on soil characteristics, soil types, crops grown, production goals, and similar factors, the use of supplemental nutrients may be necessary. Essential Practices for Nutrient Management applied by the NRCS enable the producer to supply plant nutrients for optimum forage and crop yields while meeting Quality Criteria. The identified Quality Criteria include: Maintaining or improving the chemical and biological condition of the soil; Minimization or prevention of potential nonpoint source pollution of surface or groundwater from nutrient loss; and management of nutrient deficiency or excess.

The "Wyoming Ground Water Vulnerability Assessment Handbook, Volumes 1 and 2" can provide valuable assistance in identifying areas where ground water is most sensitive to these types of activities. The handbook is available for viewing at all local NRCS Field Offices (see Page 3) or can be ordered at cost from the University of Wyoming - Spatial Data and Visualization Center (307) 766 - 2532.

Best Management Practices may be developed to include but are not limited to the following practices (the number codes listed refer to the USDA Natural Resources Conservation Service's Standard and Specification number or the University of Wyoming's Publication number): Additional information on nutrient management practices is available in many Agricultural Publications.

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Conservation Cover (327) Conservation Crop Rotation (328) Conservation Tillage Systems (329 A,B,C) Contour Farming (330) Cover and Green Manure Crop (340) Residue Mgmt. Seasonal (344) Filter Strip (393) Grassed Waterway (412) Irrigation Systems (441), (442), (443) Irrigation Water Management (449) Nutrient Management (590) Prescribed Grazing (528) Pasture and Hayland Planting (512) Roof Runoff Management (558) Runoff Management System (570) Sediment Basin (350)[1] Stripcropping, contour (585) Terrace (600) Waste Management System (312) Waste Storage Pond (425)[1] Waste Storage Structure (313)[1] Waste Treatment Lagoon (359)[1] Waste Utilization (633) [Reference DEQ Guidelines and Standards for the Land Application of Wastes and Waste-waters] Water and Sediment Control Basin (638)[1] Well (642)[1]	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (WWRC Pub. # 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP-73.6) Application Uniformity of Sprinkler Irrigation Systems (MP-73.7) Irrigation Water Quantity and Application Time (MP-73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP-73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP-73.10 Irrigation Water Measurement: Irrigation Ditches and Pipelines (B-583R) Groundwater Contamination (B-973) Chemigation Equipment and Calibration Procedures (B-1023) Chemigation Practices for Wyoming (B-1024) Nitrogen Management and Compensation for Early Harvest Sugar Beets (B-1011) Profitable Nitrogen Management for Sugar Beets (B1015) Nutrient Management for Dry Bean Production (B1016) Guide to Fertilizer Recommendations (B1045) Soils of Wyoming - Digital Map 1:500,000 Scale (B1069)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Advice should be sought from appropriate technical specialists concerning the type, amount, rate, and method of application of nutrients applied. Proximity to surface and groundwater sources should be taken into consideration. Consideration also needs to be given to insuring nutrients are available in amounts necessary to assure crops are not placed under stress that may result in reduced yields.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, Wyoming Department of Environmental Quality, University of Wyoming, chemical/fertilizer dealers, and consultants.

REFERENCES: The above numbered standards and specifications as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and local Conservation Districts. Practice standards and specifications may also be available from other federal and state agencies as well as other sources.

Other technical references include:

(1) Guide to Fertilizer Recommendations in Wyoming - A publication prepared by the University of Wyoming Cooperative Extension Service.

(2) NRCS National Engineering Handbook, Issued April 1992, Part 651, Agricultural Waste Management Field Handbook.

(3) Wyoming Ground Water Vulnerability Assessment Handbook, 1998, University of Wyoming - Spatial Data and Visualization Center, Report 98-01.

PRACTICE #3 - BEST MANAGEMENT PRACTICES FOR CONTROLLING OR PREVENTING **PESTICIDE** POLLUTION FROM CROPLAND, PASTURE/ HAYLAND, AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent pesticides from entering the surface and subsurface waters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, and hayland where pesticides are applied and are causing, or have the potential to cause, excessive pesticide level loading into surface or groundwaters.

EXPLANATION: Depending on degree of pest infestation, soil characteristics, crops grown, production goals, and similar factors, the use of pesticides may be necessary. Essential Practices for Pesticide Management are applied to be consistent with selected crop production goals and environmentally acceptable. Best Management Practices may be developed to include but are not limited to the following practices (the number codes listed refer to the USDA Natural Resources Conservation Service's Standard and Specification number or the University of Wyoming's Publication number):

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Conservation Cover (327) Conservation Crop Rotation (328) Conservation Tillage Systems (329 A, B, C) Contour Farming.(330) Cover and Green Manure Crop (340) Residue Mgmt. Seasonal (344) Filter Strip (393) Grassed Waterway (412) Irrigation System (441), (442), (443) Irrigation Water Management (449) Prescribed Grazing (528) Pasture and Hayland Planting (512) Pest Management (595) Runoff Management System (570) Roof Runoff Management (558) Sediment Basin (350)[1] Stripcropping, contour (585) Terrace (600) Waste Management System (312) Waste Storage Pond (425)[1] Waste Storage Structure (313)[1] Waste Treatment Lagoon (359)[1] Waste Utilization (633) [Reference DEQ Guidelines and Standards for the Land Application of Wastes and Waste-waters] Water and Sediment Control Basin (638)[1] Well (642)[1]	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (WWRC Pub. # 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP-73.6) Application Uniformity of Sprinkler Irrigation Systems (MP-73.7) Irrigation Water Quantity and Application Time (MP-73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP-73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP-73.10 Groundwater Contamination (B-973) Chemigation Equipment and Calibration Procedures (B-1023) Chemigation Practices for Wyoming (B-1024) Irrigation Water Measurement: Irrigation Ditches and Pipelines (B-583R) Trap Crops; A Promising Alternative for Sugar Beet Nematode Control (B-1029R) Trap Crop Radish Use in Sugar Beet - Malt Barley Rotation of the Big Horn Basin (B- 1068) 10 Steps to Successful Trap Crop Use in the Big Horn Basin (B-1072) USDA Record Keeping Requirements for Applicators Who Apply Restricted Use Pesticides (MP 93.1) 1/128 Method of Calibration: Calibrating Multiple Nozzle Boom -Type Sprayers (MP 93.3) 1/128 Method of Calibration: Calibrating hand Sprayers and High Pressure Handguns (MP 93.4) Pest and Beneficial Insects of Wyoming's Principal Crops (B-1013) High Plains Integrated Pest Management Guide (CSU 564A) Insect Management Guide- Field Crops (MP 85) Rangeland Grasshopper Management (B-980)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Advice should be sought from appropriate technical specialists concerning the type, amount, rate, timing, and method of application of pesticides applied. Proximity to surface and groundwater sources should be taken into consideration. The "Wyoming Ground Water Vulnerability Assessment Handbook, Volume 1 and 2" can assist in determining the sensitivity of the ground water to this type of activity. Potential impacts to fish and wildlife should be considered in the development of pesticide management plans. Pesticides must be applied in accordance with federal and state regulations according to the product label.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, Wyoming Department of Environmental Quality, University of Wyoming, chemical/fertilizer dealers, and consultants.

REFERENCES: The above numbered standards and specifications as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and the local Conservation Districts. Practice standards and specifications may also be available from other federal and state agencies as well as other sources.

Other technical references include:

(1) Wyoming State Management Plan for Pesticides in Groundwater, 1999, Wyoming Department of Agriculture - Technical Services Section.

(2) Wyoming Ground Water Vulnerability Assessment Handbook, Volume 2, Assessing Ground Water Vulnerability to Pesticides, 1998, University of Wyoming - Spatial Data and Visualization Center, Report 98-01.

(3) Pesticides and Wildlife: A Guide to Reduce Impacts on Animals and Their Habitat, Virginia Department of Game and Inland Fisheries, Publication 420-004, 44 pp.

(4) Wildlife and Pesticides: A Practical Guide to Reducing the Risk, North Dakota State University, Extension Service, WL-1017, 22 pp.

(5) Wyoming Weed Control Series - A series of 12 publications prepared by the University of Wyoming Cooperative Extension Service.

(6) Control of Field Crop Insects - Publication prepared by the University of Wyoming Cooperative Extension Service.

(7) Methods of Application, Product Selection and Monitoring - Publication prepared by the Wyoming Department of Agriculture.

(8) Factors Affecting Pesticide Leaching - Publication prepared by Utah Department of Agriculture.

PRACTICE #4 - BEST MANAGEMENT PRACTICES FOR CONTROLLING OR PREVENTING **SALT** POLLUTION FROM CROPLAND, PASTURE/ HAYLAND, AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent salts from entering the surface and subsurface waters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, and hayland where salts are causing, or have the potential to cause, excessive salt level loading into surface or groundwaters.

EXPLANATION: Depending on soil characteristics and chemistry, soil types, crops grown, method of irrigation, production goals, and similar factors, inherent salt concentrations may be leached into groundwater supplies or carried away in surface runoff. The Best Management Practices may be developed to include but are not limited to the following practices (the number codes listed refer to the USDA Natural Resources Conservation Service's Standard and Specification number or the University of Wyoming's Publication number):

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Conservation Crop Rotation (328) Cover and Green Manure Crop (340) Critical Area Planting (342) Filter Strip (393) Irrigation Land Leveling (464) Irrigation System (441), (442), (443) Irrigation Water Conveyance (428), (430) Irrigation Water Management (449) Pond Sealing or Lining (521)[1] Roof Runoff Management (558) Runoff Management System (570) Subsurface Drain (606)[1] Surface Drainage Field Ditch (607) Surface Drainage Main or Lateral (608) Soil Salinity Management (571) Toxic Salt Reduction (610) Water Table Control (641)	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (WWRC Pub. # 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP-73.6) Application Uniformity of Sprinkler Irrigation Systems (MP-73.7) Irrigation Water Quantity and Application Time (MP-73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP-73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP-73.10 Irrigation Water Measurement: Irrigation Ditches and Pipelines (B-583R)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Practices should be implemented in accordance with appropriate technical specifications to assure planned salt reduction benefits are realized. Advice should be sought from appropriate technical specialists to identify the level of salt loading, source of salt, and level of control that may be accomplished.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, Wyoming Department of Environmental Quality, University of Wyoming, and consultants.

REFERENCES: The above numbered standards and specifications as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and the local Conservation Districts. Practice standards and specifications may also be available from other federal and state agencies as well as other sources.

PRACTICE #5 - BEST MANAGEMENT PRACTICES FOR CONTROLLING OR PREVENTING **PATHOGEN** POLLUTION FROM CROPLAND, PASTURE/HAYLAND, AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent pathogens from entering the surface and subsurface waters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, or hayland where manure or sewage sludge is applied and is causing, or has the potential to cause, excessive level of pathogen, loading into surface or groundwaters.

EXPLANATION: Depending on soil characteristics, soil types, crops grown, amount of manure/sludge applied, rate of application, timing of application, and similar factors, care needs to be taken to reduce the impairment potential that may be caused by pathogens. Since animal waste is not a land use, the NRCS does not recognize Essential Practices; however, the NRCS does have a Waste Utilization Standard. This standard is applied as a component of a Resource Management System to utilize Agricultural Waste on land in an environmentally acceptable manner. Water resources are safeguarded by assuring that wastes are applied and incorporated in a manner that protects surface and ground water quality. The Best Management Practices may be developed to include but are not limited to the following practices (the number codes listed refer to the USDA Natural Resources Conservation Service's Standard and Specification number or the University of Wyoming's Publication number):

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Dike (356) Diversion (362) Filter Strip (393) Grassed Waterway (412) Irrigation Systems (441), (442), (443) Irrigation Water Conveyance (428), (430) Irrigation Water Management (449) Nutrient Management (590) Pond Sealing (521)[1] Roof Runoff Management (558) Runoff Management System (570) Sediment Basin (350)[1] Subsurface Drain (606)[1] Surface Drains (607), (608) Terrace (600) Waste Management System (312) Waste Storage Pond (425)[1] Waste Storage Structure (313)[1] Waste Treatment Lagoon (359)[1] Waste Utilization (633) [Also refer to DEQ Guidelines and Standards for the Land Application of Wastes and Waste-waters] Water and Sediment Control Basin (638)[1] Well (642)[1]	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (WWRC Pub. # 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP-73.6) Application Uniformity of Sprinkler Irrigation Systems (MP-73.7) Irrigation Water Quantity and Application Time (MP-73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP-73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP-73.10 Irrigation Water Measurement: Irrigation Ditches and Pipelines (B-583R)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Practices should be implemented in accordance with appropriate technical specifications to assure planned pathogen control benefits are realized. Advice should be sought from appropriate technical specialists to determine storage facility requirements, as well as the amount, rate, timing of application, and method of application of manure/sludge applied to agricultural lands. The development of a Nutrient Management Plan for animal waste is recommended. Proximity to surface and groundwater sources should be taken into consideration. The "Wyoming Ground Water Vulnerability Assessment Handbook, Volumes 1 and 2" can provide assistance in identifying areas most sensitive to these types of activities.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, University of Wyoming, and consultants.

REFERENCES: The above numbered standards and specifications as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and the local soil conservation district. Practice standards and specifications may also be available from other federal and state agencies as well as other sources.

Other technical references include:

(1) Agricultural Waste Management Field Manual - Publication prepared by the Natural Resources Conservation Service.

(2) NRCS National Engineering Handbook, Issued April 1992, Part 651, Agricultural Waste Management Field Handbook.

(3) Wyoming Ground Water Vulnerability Assessment Handbook, Volumes 1 and 2, 1998, University of Wyoming - Spatial Data and Visualization Center, Report 98-01.

PRACTICE #6 - BEST MANAGEMENT PRACTICES FOR CONTROLLING OR PREVENTING **HEAVY METAL** POLLUTION FROM CROPLAND, PASTURE/ HAYLAND, AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent heavy metals from entering the surface and groundwaters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, or hayland where manure or sewage sludge is applied and is causing, or has the potential to cause, excessive levels of heavy metals loading into surface or groundwaters.

EXPLANATION: Depending on soil characteristics, soil types, crops grown, amount of manure/sludge applied, rate of application, timing of application, and similar factors, care needs to be taken to reduce the impairment potential that may be caused by heavy metals. The Best Management Practices may be developed to include but are not limited to the following practices (the number codes listed refer to the USDA Natural Resources Conservation Service's Standard and Specification number or the University of Wyoming's Publication number):

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Dike (356) Diversion (362) Filter Strip (393) Grassed Waterway (412) Irrigation Systems (441), (442), (443) Irrigation Water Conveyance (428), (430) Irrigation Water Management (449) Nutrient Management (590) Pond Sealing (521)[1] Roof Runoff Management (558) Runoff Management System (570) Sediment Basin (350)[1] Subsurface Drain (606)[1] Surface Drains (607), (608) Waste Management System (312) Waste Storage Pond (425)[1] Waste Storage Structure (313)[1] Waste Treatment Lagoon (359)[1] Waste Utilization (633) [Also refer to DEQ Guidelines and Standards for the Land Application of Wastes and Waste-waters] Water and Sediment Control Basin (638)[1] Well (642)[1]	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (WWRC Pub. # 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP-73.6) Application Uniformity of Sprinkler Irrigation Systems (MP-73.7) Irrigation Water Quantity and Application Time (MP-73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP-73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP-73.10 Irrigation Water Measurement: Irrigation Ditches and Pipelines (B-583R) Long-Term Land Application of Biosolids: Soil and Plant Trace Element Composition (B-1062)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Practices should be implemented in accordance with appropriate technical specifications to assure planned heavy metal control benefits are realized. Advice should be sought from

appropriate technical specialists to determine storage facility requirements, as well as the amount, rate, timing of application, and method of application of manure/sludge applied to agricultural lands. Proximity to surface and groundwater sources should also be taken into consideration. The "Wyoming Ground Water Vulnerability Assessment Handbook, Volumes 1 and 2 can provide assistance in identifying areas sensitive to these types of activities.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, Wyoming Department of Environmental Quality, University of Wyoming, and consultants.

REFERENCES: The above numbered standards and specifications as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and the local soil conservation district. Practice standards and specifications may also be available from other federal and state agencies as well as other sources.

Other technical references include:

(1) Agricultural Waste Management Field Manual - Publication prepared by the Natural Resources Conservation Service.

(2) Wyoming Ground Water Vulnerability Assessment Handbook, Volume 1 and 2, 1998, University of Wyoming - Spatial Data and Visualization Center, Report 98-01.

PRACTICE # 7 - BEST MANAGEMENT PRACTICES FOR CONTROLLING OR PREVENTING **SELENIUM** POLLUTION FROM CROPLAND, PASTURE/ HAYLAND. AND ANIMAL WASTE

OBJECTIVE: To reduce or prevent selenium from entering surface and groundwaters of the state.

CONDITION WHERE PRACTICES APPLY: On cropland, pastureland, or hayland where irrigation of seleniferous soils can dissolve and mobilize selenium into surface and groundwaters.

EXPLANATION: Depending on soil characteristics and chemistry, soil types (soils derived from Cretaceous shales), crops grown, source of irrigation water, and method of irrigation; deep percolation and excess runoff from irrigation can mobilize and transport selenium into surface and groundwater and eventually into wetlands inhabited by fish and migratory birds. Excessive selenium in these waters can cause mortality and reproductive impairment in wildlife.

NRCS SPECIFICATIONS	UNIVERSITY OF WYOMING PUBLICATIONS
Conservation Crop Rotation (328) Critical Area Planting (342) Filter Strip (393) Irrigation Land Leveling (464) Irrigation System (441) (442) (443) Irrigation Water Conveyance (428) (430) Irrigation Water Management (449) Pond Sealing or Lining (521)1 Runoff Management System (570) Subsurface Drain (606)1 Surface Drainage Field Ditch (607) Surface Drainage Main or Lateral (608) Standard Operating Procedures for the Sampling and Analysis of Selenium in Soil, and Overburden and Spoil Material (MP - 82)	Consumptive Use and Consumptive Irrigation Requirements in Wyoming (wwrc 92-06) Distribution Tests for Sprinkler Irrigation Systems (MP - 73.6) Application Uniformity of Sprinkler Irrigation Systems (MP - 73.7) Irrigation Water Quantity and Application Time (MP - 73.8) Economics of Improvement Costs for Sprinkler Irrigation Systems (MP - 73.9) "SPIREC" - A Computer Program for Calculating Sprinkler Irrigation Pumping Plant Efficiencies, Energy Costs, and Application Uniformities (MP - 73.10) Irrigation Water Measurement: Irrigation Ditches and Pipelines (B - 583R) Standard Operating Procedures for Sampling Selenium in Vegetation (MP - 77) Standard Operating Procedures for the Sampling and Analysis of Selenium in Soil, Plant Efficiencies, Energy Costs, and Application Uniformities (MP - 73.10) Irrigation Water Measurement: Irrigation Ditches and Pipelines (B - 583R) Standard Operating Procedures for Sampling Selenium in Vegetation (MP - 77) Standard Operating Procedures for the Sampling and Analysis of Selenium in Soil, and Overburden and Spoil Material (MP - 82)

[1] *Permits from Wyoming Department of Environmental Quality and/or the Wyoming State Engineer's Office may be required/necessary.*

CONCERNS: Practices should be implemented in accordance with appropriate technical specifications to assure planned selenium reduction benefits are achieved.

TECHNICAL SUPPORT: Individual Conservation Districts, Agricultural Extension Offices, Natural Resources Conservation Service, Environmental Protection Agency, Wyoming Department of Agriculture, Wyoming Department of Environmental Quality, University of Wyoming, U. S. Fish and Wildlife Service, and consultants.

REFERENCES: The above numbered standards and specifications as well as application and construction guides and/or specifications are available at local offices of the Natural Resources Conservation Service and local Conservation Districts. Practice standards and specifications may also be available from other federal and state agencies as well as other sources.

Other technical references include:

(1) The Uncompahgre Valley BMP Decision Committee. 1996. Best Management Practices for Agriculture in the Uncompahgre Valley. Shavano Soil Conservation District and Colo. State Univ., Montrose, CO. 36 pp.

(2) Areas susceptible to Irrigation-Induced Selenium Contamination of Water and Biota in the Western United States. Seiler, R. L., Skorupa, J. P., Peltz, L. A., 1999, USGS Circular 1180, 36 pp.

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