



RG-348
Revised July 2005

Complying with the Edwards Aquifer Rules Technical Guidance on Best Management Practices

Field Operations Division

printed on
recycled paper

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Complying with the Edwards Aquifer Rules

Technical Guidance on Best Management Practices

Prepared for
Field Operations Division

by Michael E. Barrett, Ph.D., P.E.
Center for Research in Water Resources
Bureau of Engineering Research
University of Texas at Austin

RG-348 (Revised)
July 2005



Kathleen Hartnett White, Chairman
R. B. "Ralph" Marquez, Commissioner
Larry R. Soward, Commissioner

Glenn Shankle, Executive Director

Authorization to use or reproduce any original material contained in this publication—that is, not obtained from other sources—is freely granted. The commission would appreciate acknowledgment.

Copies of this publication are available for public use through the Texas State Library, other state depository libraries, and the TCEQ Library, in compliance with state depository law. For more information on TCEQ publications, call 512/239-0028 or visit our Web site at:

www.tceq.state.tx.us/publications

Published and distributed
by the
Texas Commission on Environmental Quality
PO Box 13087
Austin TX 78711-3087

The TCEQ is an equal opportunity/affirmative action employer. The agency does not allow discrimination on the basis of race, color, religion, national origin, sex, disability, age, sexual orientation or veteran status. In compliance with the Americans with Disabilities Act, this document may be requested in alternate formats by contacting the TCEQ at 512/239-0028, Fax 239-4488, or 1-800-RELAY-TX (TDD), or by writing P.O. Box 13087, Austin, TX 78711-3087.

Preface

The Edwards Aquifer is one of the most valuable resources in the central Texas area. This aquifer provides water for municipal, industrial, and agricultural uses as well as sustaining a number of rare and endangered species. To preserve these beneficial uses, Texans must protect water quality in this aquifer from degradation resulting from human activities.

The Edwards Aquifer rules are an effective mechanism we can use to protect this valuable resource. Found in Title 30 Texas Administrative Code Chapter 213, these rules address activities that could pose a threat to water quality in the Edwards Aquifer, including wells and springs fed by the aquifer and water sources to the aquifer, including uplands areas draining directly to it and surface streams. These rules apply specifically to the Edwards Aquifer in eight counties and are not intended for any other aquifers in Texas.

To keep this manual current, we will periodically review and revise material that needs updating in response to changes in the rules or the availability of new or improved technology. We will make these updated portions available through our Publications Unit and through the Edwards Aquifer Protection Program page on our Web site (<http://www.tnrc.state.tx.us/eapp>).

We would like to thank Michael E. Barrett, Ph.D., P.E., Center for Research in Water Resources, Bureau of Engineering Research, University of Texas at Austin for his contribution of drafting and editing the chapters containing technical guidance (see his note below). We would also like to thank the members of the regulated community who participated through our Technical Review Work Group in the development of this manual.

Dr. Barrett adds:

The material in the technical guidance chapters of this manual was adapted primarily from guidance documents adopted by other state, regional, and municipal agencies. Preference was given to materials developed in Texas. Primary source included the City of Austin, the Lower Colorado River Authority, and the North Central Texas Council of Governments. Material from other parts of the country was modified to conform to specific climatic, soil, geologic, and other constraints present in the contributing and recharge zones of the Edwards Aquifer.

This guidance document was greatly improved by the contributions and comments of many readers. In particular, the staffs of the Austin and San Antonio regional offices of the TCEQ provided material as well as comments. Helpful suggestions were also received from municipalities, agencies responsible for water quality, and many in the consulting industry. I will refrain from naming these parties for fear of implying their approval of all aspects of this manual; nevertheless, their contributions were greatly appreciated.

Table of Contents

CHAPTER 1 TEMPORARY BEST MANAGEMENT PRACTICES	1-1
1.1 INTRODUCTION	1-1
1.2 GENERAL GUIDELINES	1-2
1.3 TEMPORARY EROSION CONTROL BMPs	1-9
1.3.1 <i>Interceptor Swale</i>	1-11
1.3.2 <i>Diversion Dikes</i>	1-13
1.3.3 <i>Pipe Slope Drain</i>	1-16
1.3.4 <i>Polyacrylamide</i>	1-18
1.3.5 <i>Outlet Stabilization</i>	1-21
1.3.6 <i>Level Spreaders</i>	1-25
1.3.7 <i>Subsurface Drains</i>	1-29
1.3.8 <i>Temporary Vegetation</i>	1-35
1.3.9 <i>Blankets and Matting</i>	1-39
1.3.10 <i>Hydraulic Mulch</i>	1-52
1.3.11 <i>Sod</i>	1-53
1.3.12 <i>Dust Control</i>	1-59
1.4 TEMPORARY SEDIMENT CONTROL BMPs	1-61
1.4.1 <i>General Guidelines</i>	1-61
1.4.2 <i>Temporary Construction Entrance/Exit</i>	1-63
1.4.3 <i>Silt Fence</i>	1-66
1.4.4 <i>Triangular Sediment Filter Dikes</i>	1-69
1.4.5 <i>Rock Berms</i>	1-72
1.4.6 <i>High Service Rock Berms</i>	1-75
1.4.7 <i>Brush Berms</i>	1-78
1.4.8 <i>Check Dams</i>	1-82
1.4.9 <i>Sand Bag Berm</i>	1-85
1.4.10 <i>Vegetative Buffers</i>	1-88
1.4.11 <i>Inlet Protection</i>	1-89
1.4.12 <i>Stone Outlet Sediment Trap</i>	1-101
1.4.13 <i>Sediment Basins</i>	1-104
1.4.14 <i>Fiber Rolls</i>	1-109
1.4.15 <i>Dewatering Operations</i>	1-111
1.4.16 <i>Spill Prevention and Control</i>	1-118
1.4.17 <i>Utility Line Creek Crossings</i>	1-122
1.4.18 <i>Concrete Washout Areas</i>	1-124
CHAPTER 2 NON-STRUCTURAL BEST MANAGEMENT PRACTICES	2-1
2.1 INTRODUCTION	2-1
2.2 COMPREHENSIVE SITE PLANNING.....	2-3
2.2.1 <i>Introduction</i>	2-3
2.2.2 <i>The Site Planning Process</i>	2-6
2.2.3 <i>Preserving Natural Runoff Conditions</i>	2-7

2.3 PESTICIDE AND FERTILIZER MANAGEMENT	2-9
2.3.1 <i>Introduction</i>	2-9
2.3.2 <i>Integrated Pest Management</i>	2-11
2.3.3 <i>Mechanical Controls</i>	2-14
2.3.4 <i>Biological Controls</i>	2-16
2.3.5 <i>Recommended Chemical Controls</i>	2-16
2.3.6 <i>Traditional Chemical Controls</i>	2-18
2.4 HOUSEKEEPING PRACTICES	2-21
2.5 LANDSCAPING AND VEGETATIVE PRACTICES	2-25
2.5.1 <i>Tree Protection</i>	2-25
2.5.2 <i>Stormwater Basin Landscaping</i>	2-38
2.5.3 <i>Xeriscape Programs</i>	2-40
2.5.4 <i>Lawn/Turf/Grass Management</i>	2-40
2.5.5 <i>Preservation of Riparian Areas</i>	2-41
CHAPTER 3 PERMANENT STRUCTURAL BEST MANAGEMENT PRACTICES	3-1
3.1 INTRODUCTION	3-1
3.2 BMP APPLICABILITY.....	3-3
3.2.1 <i>Introduction</i>	3-3
3.2.2 <i>Retention/Irrigation</i>	3-6
3.2.3 <i>Extended Detention Basins</i>	3-8
3.2.4 <i>Grassy Swales</i>	3-10
3.2.5 <i>Vegetative Filter Strips</i>	3-12
3.2.6 <i>Sand Filter Systems</i>	3-14
3.2.7 <i>Bioretention</i>	3-16
3.2.8 <i>Wet Basins</i>	3-18
3.2.9 <i>Constructed Wetlands</i>	3-20
3.2.10 <i>AquaLogicTM Cartridge Filter System</i>	3-22
3.2.11 <i>Wet Vaults</i>	3-23
3.2.12 <i>Permeable Concrete</i>	3-24
3.3 TSS REMOVAL AND BMP SIZING CALCULATIONS	3-26
3.3.1 <i>Introduction</i>	3-26
3.3.2 <i>Sizing Calculations</i>	3-27
3.3.3 <i>Offsite Drainage</i>	3-36
3.4 BMP DESIGN CRITERIA	3-37
3.4.1 <i>General Requirements for Maintenance Access</i>	3-37
3.4.2 <i>Basin Lining Requirements</i>	3-38
3.4.3 <i>Retention/Irrigation</i>	3-42
3.4.4 <i>Extended Detention Basins</i>	3-46
3.4.5 <i>Grassy Swales</i>	3-51
3.4.6 <i>Vegetative Filter Strips</i>	3-55
3.4.7 <i>Sand Filter Systems</i>	3-58
3.4.8 <i>Bioretention</i>	3-63
3.4.9 <i>Wet Basins</i>	3-66
3.4.10 <i>Constructed Wetland</i>	3-71
3.4.11 <i>AquaLogic^Ô Cartridge Filter System</i>	3-74
3.4.12 <i>Wet Vaults</i>	3-79

3.4.13 <i>Permeable Concrete</i>	3-79
3.5 MAINTENANCE GUIDELINES	3-83
3.5.1 <i>Maintenance Plan</i>	3-83
3.5.2 <i>General Guidelines</i>	3-84
3.5.3 <i>Basin Dewatering</i>	3-86
3.5.4 <i>Sediment Disposal</i>	3-86
3.5.5 <i>Retention/Irrigation</i>	3-87
3.5.6 <i>Extended Detention Basins</i>	3-88
3.5.7 <i>Grassy Swales</i>	3-90
3.5.8 <i>Vegetative Filter Strips</i>	3-91
3.5.9 <i>Sand Filter Systems</i>	3-92
3.5.10 <i>Bioretention</i>	3-94
3.5.11 <i>Wet Basins</i>	3-96
3.5.12 <i>Constructed Wetland</i>	3-98
3.5.13 <i>AquaLogic Cartridge Filter System</i>	3-99
3.5.14 <i>Wet Vaults</i>	3-101
3.5.15 <i>Permeable Concrete</i>	3-102
3.6 EROSION PREVENTION	3-103
CHAPTER 4 INNOVATIVE TECHNOLOGY: USE AND EVALUATION	4-1
4.1 QUALITY ASSURANCE PROJECT PLAN (QAPP)	4-1
4.2 INFORMATION ABOUT THE TECHNOLOGY.....	4-2
4.3 STORMWATER FIELD SAMPLING PROCEDURES	4-4
4.4 FULL-SCALE LABORATORY STUDIES	4-7
4.5 LABORATORY QA PROCEDURES	4-8
4.6 DATA MANAGEMENT PROCEDURES	4-8
4.7 DATA REVIEW, VERIFICATION, AND VALIDATION.....	4-9
CHAPTER 5 MANAGEMENT OF SENSITIVE FEATURES	5-1
5.1 PROTECTION OF SENSITIVE FEATURES IDENTIFIED IN THE GEOLOGICAL ASSESSMENT.....	5-1
5.1.1 <i>Small Depressions with Earthen Bottoms</i>	5-1
5.1.2 <i>Sensitive Features</i>	5-2
5.1.3 <i>Caves</i>	5-3
5.2 PROTECTION OF FEATURES IDENTIFIED DURING CONSTRUCTION	5-8
CHAPTER 6 EXAMPLE CALCULATIONS	6-1
6.1 INTRODUCTION	6-1
6.2 REQUIRED TSS REDUCTION.....	6-1
6.3 EXAMPLE CAPTURE VOLUME CALCULATIONS	6-2
6.3.1 <i>Retention/Irrigation</i>	6-2
6.3.2 <i>Sand Filter System</i>	6-3
6.3.3 <i>Combination Grassy Swale/Extended Detention</i>	6-4
6.3.4 <i>Wet Basins and Constructed Wetlands</i>	6-5
CHAPTER 7 BIBLIOGRAPHY	7-1

LIST OF FIGURES

Figure 1-1 Examples of Proper and Improper Siting (North Carolina, 1993)	1-2
Figure 1-2 Example of Conservative Site Clearing (North Carolina, 1993)	1-4
Figure 1-3 Diversion of Runoff away from Construction Area (North Carolina, 1993).	1-5
Figure 1-4 Slow Runoff by Breaking Slopes (North Carolina, 1993)	1-6
Figure 1-5 Stabilization of Disturbed Areas (North Carolina, 1993)	1-7
Figure 1-6 Retention of Eroded Sediment on Site	1-9
Figure 1-7 Schematic Diagram of an Interceptor Swale.....	1-12
Figure 1-8 Schematic of a Diversion Dike (NCTCOG, 1993b)	1-15
Figure 1-9 Schematic Diagram of a Slope Drain (NCTCOG, 1993).....	1-17
Figure 1-10 Examples of Stilling Basin Designs (North Carolina, 1993)	1-22
Figure 1-11 Riprap Outlet Design (North Carolina, 1993)	1-24
Figure 1-12 Perspective View of a Level Spreader (VA Dept of Conservation, 1992) 1-	26
Figure 1-13 Cross-Section of a Level Spreader (VA Dept of Conservation, 1992)	1-28
Figure 1-14 Effect of Subsurface Drain (VA Dept. of Conservation, 1992).....	1-29
Figure 1-15 Subsurface Drainage Patterns (VA Dept. of Conservation, 1992).....	1-30
Figure 1-16 Surface Inlets for Subsurface Drains (VA Dept. of Conservation, 1992)..	1-33
Figure 1-17 Subsurface Drain Envelope (VA Dept. of Conservation, 1992).....	1-34
Figure 1-18 Planting Dates for Hays, Travis, and Williamson Counties (Northcutt, 1993)	
.....	1-36
Figure 1-19 Planting Dates for Bexar, Comal, Kinney, Medina, and Uvalde Counties (Northcutt, 1993).....	1-36
Figure 1-20 Initial Anchor Trench for Blankets and Mats	1-50
Figure 1-21 Terminal Anchor Trench for Blankets and Mats	1-50
Figure 1-22 Proper Sod Installation Techniques (VA Dept. of Conservation, 1992)....	1-56
Figure 1-23 Installation of Sod in a Channel (VA Dept. of Conservation, 1992)	1-58
Figure 1-24 Schematic of Temporary Construction Entrance/Exit (after NC, 1993)....	1-63
Figure 1-25 Cross-section of a Construction Entrance/Exit (NC, 1993)	1-63
Figure 1-26 Schematic of a Silt Fence Installation (NCTCOG, 1993b)	1-66
Figure 1-27 Schematic of a Triangular Filter Dike (NCTCOG, 1993).....	1-70
Figure 1-28 Schematic Diagram of a Rock Berm (NCTCOG, 1993).....	1-73

Figure 1-29 Schematic Diagram of High Service Rock Berm (LCRA, 1998)	1-75
Figure 1-30 Schematic Diagram of a Brush Berm (VA Dept. of Conservation, 1992).1-79	
Figure 1-31 Diagram of a Rock Check Dam (VA Dept. of Conservation, 1992)	1-83
Figure 1-32 Schematic of a Sand Bag Berm (NCTCOG, 1993).....	1-86
Figure 1-33 Filter Fabric Inlet Protection (NCTCOG, 1993)	1-91
Figure 1-34 Wire Mesh and Gravel Inlet Protection (NCTCOG, 1993)	1-92
Figure 1-35 Block and Gravel Inlet Protection (NCTCOG, 1993).....	1-94
Figure 1-36 Excavated Inlet Protection (NCTCOG, 1993)	1-95
Figure 1-37 Wooden Weir Curb Inlet Protection (VA Dept of Conservation, 1992)....	1-97
Figure 1-38 Diagram of Bagged Gravel Grate Inlet Protection (Pape-Dawson)	1-98
Figure 1-39 Diagram of Bagged Gravel Curb Inlet Protection (Pape-Dawson).....	1-99
Figure 1-40 Schematic Diagram of a Sediment Trap (NCTCOG, 1993)	1-103
Figure 1-41 Schematic of a Sediment Basin (NCTCOG, 1993).....	1-105
Figure 1-42 Utility Line Creek Crossing (LCRA, 1998).....	1-123
Figure 1-43 Schematics of Concrete Washout Areas	1-125
Figure 2-1 Examples of Tree Fencing (VA Dept of Conservation, 1992).....	2-31
Figure 2-2 Example of a Tree Well (VA Dept of Conservation, 1992)	2-32
Figure 2-3 Tree Well with Higher Finished Grade (VA Dept of Conservation, 1992) .2-33	
Figure 2-4 Example of a Tree Wall (VA Dept of Conservation, 1992)	2-35
Figure 2-5 Effect of Tunneling and Trenching on Tree Roots	2-37
Figure 3-1 Schematic of an Extended Detention Basin (NCTCOG, 1993)	3-8
Figure 3-2 Section of a Typical Swale (King County, 1996)	3-10
Figure 3-3 Filter Strip	3-12
Figure 3-4 Schematic of a Sand Filter System (Young et al., 1996)	3-14
Figure 3-5 Schematic of a Bioretention Facility (MDE, 2000)	3-17
Figure 3-6 Schematic of a Wet Basin (Young et al., 1996).....	3-18
Figure 3-7 Schematic of a Constructed Wetland (Schueler et al., 1992).....	3-20
Figure 3-8 Diagram of a Cartridge Filter System	3-22
Figure 3-9 Permeable Concrete in Parking Lot at a Recreational Center	3-25
Figure 3-10 Annual TSS Removal as a Function of Overflow Rate	3-31
Figure 3-11 Relationship between Rainfall Intensity and Fraction Treated	3-32

Figure 3-12 Relationship between Runoff Coefficient and Impervious Cover	3-36
Figure 3-13 Example of Liner Installation on Earthen Slope (Courtesy COA)	3-39
Figure 3-14 Pond Liner Attached to Exterior of Rock Wall (Courtesy COA)	3-40
Figure 3-15 Example of Liner Installed Prior to Concrete Pour (Courtesy COA)	3-41
Figure 3-16 Sprinkler Head Detail.....	3-44
Figure 3-17 Schematic of a two stage Extended Detention Basin (LCRA, 1998)	3-48
Figure 3-18 Schematic of an Enhanced Extended Detention Basin (Schueler, 1992)...	3-48
Figure 3-19 Schematic of Detention Basin Outlet Structure	3-50
Figure 3-20 Diagram of Grassy Swale with Check Dam	3-51
Figure 3-21 Example of Filter Strip along Roadway.....	3-57
Figure 3-22 Example Configuration of Filter Strip adjacent to Parking Lot.....	3-57
Figure 3-23 Schematic of Sand Bed Profile	3-60
Figure 3-24 Detail of Sedimentation Riser Pipe	3-62
Figure 3-25 Bioretention with Underdrain and Liner	3-65
Figure 3-26 Bioretention System with Infiltration.....	3-65
Figure 3-27 Schematic Diagrams of Wet Basin Outlets (WEF and ASCE, 1998)	3-68
Figure 3-28 Diagram of a Standard Filter Cartridge (by AquaLogic TM , 2000).....	3-75
Figure 3-29 Schematic of Underdrain Piping	3-76
Figure 3-30 Schematic of In-Pipe Bladder Valve	3-77
Figure 3-31 Schematic of Control Panel/Rain Sensor Assembly	3-78
Figure 3-32 Schematic of Permeable Concrete Installation (after UCFCD, 2004)	3-82
Figure 5-1 Typical Cave Gate with Secure Entrance (Mike Warton, PBS&J).....	5-5
Figure 5-2 Mammal Access Portals Along Edge of Gate	5-6
Figure 5-3 Example of Anchor Rebar.....	5-7
Figure 5-4 Example Cave Gate Access.....	5-8
Figure 5-5 Filled Solution Feature (courtesy Kathryn Woodlee)	5-11
Figure 5-6 Example of Filled Void in Trench Excavation (courtesy Donald Bayes)....	5-12
Figure 5-7 Utility Pipe Encased in External Steel Pipe (courtesy of Kathryn Woodlee)	
.....	5-13
Figure 5-8 Profile View of Encased Utility Pipe (courtesy of Kathryn Woodlee).....	5-14
Figure 5-9 Cavity fill with Pipe to Preserve Hydrologic Connectivity	5-15

LIST OF TABLES

Table 1-1 Summary of Temporary Erosion Control Practices	1-10
Table 1-2 Application Rates for PAM	1-20
Table 1-3 Temporary Seeding for Hays, Travis, and Williamson Counties (Northcutt, 1993)	1-37
Table 1-4 Temporary Seeding for Bexar, Comal, Kinney, Medina, and Uvalde Counties (Northcutt, 1993).....	1-37
Table 1-5 Guidelines for Selection of Sediment Control BMPs.....	1-62
Table 1-6 Design Storm Depth by County (Asquith and Roussel, 2004).....	1-106
Table 3-1 Summary of Permanent Structural BMPs with Verified Performance	3-4
Table 3-2 Impervious Cover Assumptions for Residential Tracts.....	3-28
Table 3-3 Average Annual Rainfall by County	3-28
Table 3-4 TSS Reduction of Selected BMPs	3-30
Table 3-5 Relationship between Fraction of Annual Rainfall and Rainfall Depth (in) .	3-35
Table 3-6 Clay Liner Specifications (COA, 2004)	3-38
Table 3-7 Geotextile Fabric Specifications (COA, 2004)	3-39
Table 3-8 One-year, Three-hour Storm by County (TxDOT, 1998)	3-103
Table 5-1 Minimum Protective Standards for Sewer and Storm Drain Trenches	5-10