

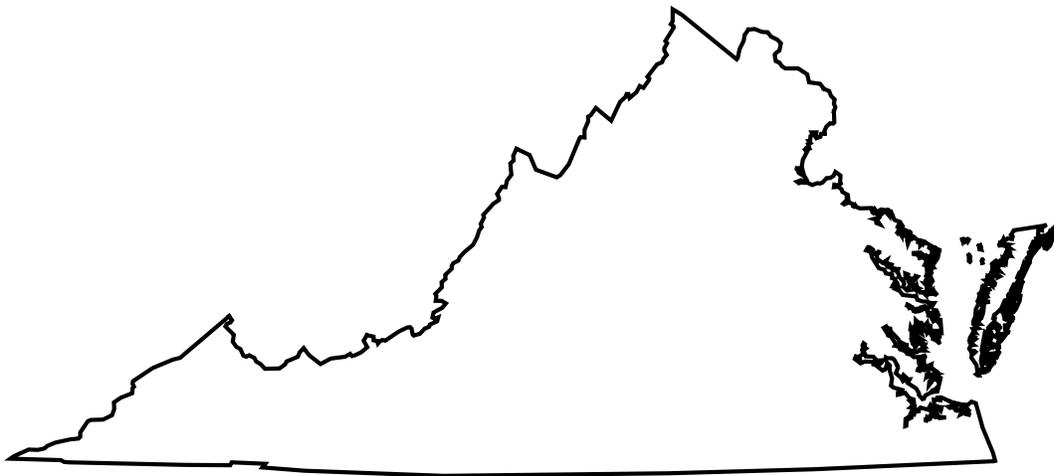
U.S. Department of the Interior
U.S. Geological Survey

Water Resources Data Virginia Water Year 2004

Volume 2. Ground-Water Level and Ground-Water Quality Records

By Roger K. White, Eugene D. Powell, Joel R. Guyer, and Joseph A. Owens

Water-Data Report VA-04-2



Prepared in cooperation with the
Virginia Department of Environmental Quality and with other agencies



Calendar for Water Year 2004

2003

October							November							December						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
			1	2	3	4							1		1	2	3	4	5	6
5	6	7	8	9	10	11	2	3	4	5	6	7	8	7	8	9	10	11	12	13
12	13	14	15	16	17	18	9	10	11	12	13	14	15	14	15	16	17	18	19	20
19	20	21	22	23	24	25	16	17	18	19	20	21	22	21	22	23	24	25	26	27
26	27	28	29	30	31		23	24	25	26	27	28	29	28	29	30	31			
							30													

2004

January							February							March						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3	1	2	3	4	5	6	7		1	2	3	4	5	6
4	5	6	7	8	9	10	8	9	10	11	12	13	14	7	8	9	10	11	12	13
11	12	13	14	15	16	17	15	16	17	18	19	20	21	14	15	16	17	18	19	20
18	19	20	21	22	23	24	22	23	24	25	26	27	28	21	22	23	24	25	26	27
25	26	27	28	29	30	31	29							28	29	30	31			

April							May							June						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3							1			1	2	3	4	5
4	5	6	7	8	9	10	2	3	4	5	6	7	8	6	7	8	9	10	11	12
11	12	13	14	15	16	17	9	10	11	12	13	14	15	13	14	15	16	17	18	19
18	19	20	21	22	23	24	16	17	18	19	20	21	22	20	21	22	23	24	25	26
25	26	27	28	29	30		23	24	25	26	27	28	29	27	28	29	30			
							30	31												

July							August							September						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3	1	2	3	4	5	6	7				1	2	3	4
4	5	6	7	8	9	10	8	9	10	11	12	13	14	5	6	7	8	9	10	11
11	12	13	14	15	16	17	15	16	17	18	19	20	21	12	13	14	15	16	17	18
18	19	20	21	22	23	24	22	23	24	25	26	27	28	19	20	21	22	23	24	25
25	26	27	28	29	30	31	29	30	31					26	27	28	29	30		

U.S. DEPARTMENT OF THE INTERIOR

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2005

PREFACE

This volume of the annual hydrologic data report of Virginia is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's and cooperating agencies' surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of streamflow, ground-water levels, and water quality provide the hydrologic information needed by State, local, and Federal agencies, and the private sector for developing and managing our Nation's land and water resources. Hydrologic data for Virginia are contained in two volumes:

Volume 1. Surface-Water-Discharge and Surface-Water-Quality Records

Volume 2. Ground-Water-Level and Ground-Water-Quality Records

This report (Volume 2) is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey and the Virginia Department of Environmental Quality who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. In addition to the authors, who had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to Geological Survey policy and established guidelines, the following personnel contributed significantly to the collection, computation, processing, and completion of this information:

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CONTENTS

	Page
Preface.....	iii
List of ground-water wells, by county or independent city, for which records are published in this volume	vi
Introduction.....	1
Cooperation.....	1
Records collected by the State of Virginia	2
Summary of hydrologic conditions.....	2
Explanation of the records	5
Station identification numbers	5
Latitude-longitude system	7
Records of ground-water levels	8
Data collection and computation.....	8
Data presentation.....	8
Records of ground-water quality	9
Data collection and computation.....	9
Data presentation.....	10
Remarks codes.....	10
Water quality-control data	10
Blank Samples.....	10
Reference Samples.....	11
Replicate Samples	11
Spike Samples	12
Access to USGS water data	12
Definition of terms.....	13
Station records, ground water	42
Ground-water levels.....	42
Quality of ground water.....	393
Index	401

ILLUSTRATIONS

Figure 1. Monthly ground-water levels at key observation wells in water-table aquifers.....	4
2. Ground-water levels in selected observation wells in confined Coastal Plain aquifers	6
3. System for numbering wells	7
4. Map of Virginia showing location of ground-water observation wells	32
5. Map of southeastern Virginia showing location of ground-water observation wells	34
6. Map of York-James peninsula and vicinity in Virginia showing location of ground-water observation wells	36
7. Map of Delmarva peninsula in Virginia showing location of ground-water observation wells.....	38
8. Map of Frederick County showing location of ground-water observation wells	39
9. Map of Virginia Beach showing location of ground-water observation wells	40

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

[SOW refers to the STATE OBSERVATION WELL numbering system as designated
by the Virginia Department of Environmental Quality]

	Page
ACCOMACK COUNTY	
Well 64H 5 SOW 102C.....	42
Well 64H 6 SOW 102A.....	43
Well 64H 7 SOW 102B.....	44
Well 64K 7 SOW 106C.....	45
Well 64K 8 SOW 106B.....	46
Well 64K 9 SOW 106A.....	47
Well 64K 10 SOW 108A.....	48
Well 64K 11 SOW 108B.....	49
Well 64K 12 SOW 108C.....	50
Well 65K 23 SOW 109C.....	51
Well 65K 24 SOW 109A.....	52
Well 65K 25 SOW 109B.....	53
Well 65K 26 SOW 109S.....	54
Well 65K 27 SOW 114A.....	55
Well 65K 28 SOW 114B.....	56
Well 65K 29 SOW 114C.....	57
Well 65K 30 SOW 114S.....	58
Well 65K 59 SOW 183A.....	59
Well 65K 60 SOW 183B.....	60
Well 65K 61 SOW 183C.....	61
Well 65K 62 SOW 183D.....	62
Well 66K 2 SOW 101C.....	63
Well 66K 3 SOW 101B.....	64
Well 66K 4 SOW 101A.....	65
Well 66L 1 SOW 107C.....	66
Well 66L 2 SOW 107A.....	67
Well 66L 3 SOW 107B.....	68
Well 66M 16 SOW 110A.....	69
Well 66M 17 SOW 110B.....	70
Well 66M 18 SOW 110C.....	71
Well 66M 19 SOW 110S.....	72
Well 66M 23 SOW 181A.....	73
Well 66M 24 SOW 181B.....	74
Well 66M 25 SOW 181C.....	75
Well 66M 26 SOW 181D.....	76
Well 66M 27 SOW 181E.....	77
Well 67M 10 SOW 115A.....	78
Well 67M 11 SOW 115B.....	79
Well 67M 13 SOW 115D.....	80
ALBEMARLE COUNTY	
Well 43N 1 SOW 028.....	81
APPOMATTOX COUNTY	
Well 41H 2.....	82
ARLINGTON COUNTY	
Well 54V 3.....	83
AUGUSTA COUNTY	
Well 38P 1 SOW 070.....	84
BUCKINGHAM COUNTY	
Well 41H 3.....	85
CAROLINE COUNTY	
Well 52N 5.....	86
Well 52N 6.....	87
Well 53M 1.....	88
CHARLES CITY COUNTY	
Well 54G 13 SOW 067.....	89

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

	Page
CHESAPEAKE (INDEPENDENT CITY)	
Well 59C 29 SOW 163A	90
Well 59C 30 SOW 163B	91
Well 59C 31 SOW 163C	92
Well 60B 3 SOW 090A	93
Well 60B 4 SOW 090B	94
Well 60C 41 SOW 164	95
Well 61B 5 SOW 091B	96
Well 61B 6 SOW 091C	97
Well 61B 12 SOW 091E	98
Well 61B 13 SOW 091F	99
Well 61B 14 SOW 091G	100
Well 61B 15 SOW 091H	101
Well 61B 16 SOW 091J	102
Well 61B 17 SOW 091K	103
Well 61B 19 SOW 091M	104
CHESTERFIELD COUNTY	
Well 51H 92	105
Well 51H 95	106
Well 51H130	107
Well 52G 22	108
Well 52G 24	109
CLARKE COUNTY	
Well 46W175	110
COLONIAL HEIGHTS (INDEPENDENT CITY)	
Well 51G 1	111
ESSEX COUNTY	
Well 55N 2	112
FAIRFAX COUNTY	
Well 52V 2	113
FRANKLIN (INDEPENDENT CITY)	
Well 55B 67 SOW 145D	114
FREDERICK COUNTY	
Well 44W 2	115
Well 44W 4	116
Well 44W 5	117
Well 44W 6	118
Well 44W 7	119
Well 44W 8	120
Well 44W 9	121
Well 44W 10	122
Well 44W 11	123
Well 44W 12	124
Well 44W 13	125
Well 44W 14	126
Well 44W 16	127
Well 44W 17	128
Well 44W 18	129
Well 44W 19	130
Well 44X 2	131
Well 44X 5	132
Well 44X 6	133
Well 45W 16	134
Well 45W 17	135
Well 45X 3	136
Well 45X 4	137
Well 45X 9	138
Well 45X 11	139

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

	Page
FREDERICK COUNTY--Continued	
Well 45X 12	140
Well 45X 13	141
Well 45X 14	142
Well 45X 15	143
Well 45X 18	144
Well 45X 19	145
Well 45X 20	146
Well 45Y 1	147
Well 45Y 2	148
Well 45Y 3	149
Well 45Y 4	150
Well 45Y 5	151
Well 45Y 6	152
Well 45Y 8	153
Well 46X108	154
Well 46X110	158
Well 46Y 1	156
GLOUCESTER COUNTY	
Well 57H 20 SOW 192A	157
Well 57H 21 SOW 192B	158
Well 57H 22 SOW 192C	159
Well 58H 6 SOW 168A	160
Well 58H 7 SOW 168B	161
Well 58H 8 SOW 168C	162
HANOVER COUNTY	
Well 51M 11	163
Well 52J 56	164
Well 53K 19 SOW 080	165
HENRICO COUNTY	
Well 50J 1 SOW 023	166
Well 51J 13	167
Well 51K 14 SOW 137	168
Well 52H 3 SOW 136	169
Well 52H 16	170
Well 52H 17	171
ISLE OF WIGHT COUNTY	
Well 55B 16	172
Well 55B 36	173
Well 55B 62 SOW 096B	174
Well 57C 25 SOW 149A	175
Well 57C 26 SOW 149B	176
Well 57C 28 SOW 149D	177
Well 57D 21 SOW 143A	178
Well 57D 22 SOW 143B	179
Well 57D 23 SOW 143C	180
Well 57E 10 SOW 144B	181
Well 57E 14 SOW 144A	182
Well 57E 15 SOW 144C	183
JAMES CITY COUNTY	
Well 55H 20	184
Well 56F 1 SOW 018	185
Well 56G 57	186
Well 56H 22 SOW 135A	187
Well 56H 25 SOW 177A	188
Well 56H 26 SOW 177B	189
Well 56H 27 SOW 177C	190
Well 56H 28 SOW 177D	191
Well 56H 29 SOW 177E	192
Well 56H 30 SOW 177F	193
Well 56H 31 SOW 135B	194
Well 57H 14 SOW 095	195
Well 58F 127 SOW 195	196

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

	Page
KING AND QUEEN COUNTY	
Well 54K 6 SOW 064	197
Well 54L 10.....	198
Well 56J 11 SOW 073.....	199
Well 57J 3 SOW 074.....	200
KING GEORGE COUNTY	
Well 54Q 21	201
Well 54 R 2	202
KING WILLIAM COUNTY	
Well 56J 2	203
Well 56J 10	204
LANCASTER COUNTY	
Well 59K 1 SOW 015	205
Well 59K 9	206
LOUDOUN COUNTY	
Well 49Y 1 SOW 022	207
Well 50W 4C.....	208
LOUISA COUNTY	
Well 45N 1	209
Well 45N 4	210
Well 46N 1 SOW 056	211
MATHEWS COUNTY	
Well 59H 1	212
Well 59H 4	214
Well 59H 6	216
Well 59H 7	218
Well 59H 8	220
MIDDLESEX COUNTY	
Well 58J 5	222
Well 59J 16	223
Well 59J 25	224
Well 59J 27	225
MONTGOMERY COUNTY	
Well 27F 2 SOW 019.....	226
NEW KENT COUNTY	
Well 53J 6	227
Well 55J 6	228
NEWPORT NEWS (INDEPENDENT CITY)	
Well 58F 1 SOW 002.....	229
Well 58F 50 SOW 171A	230
Well 58F 51 SOW 171B	231
Well 58F 52 SOW 171C	232
Well 58F 53 SOW 171D	233
Well 58F 54 SOW 171E	234
Well 58F 55 SOW 171F.....	235
NORFOLK (INDEPENDENT CITY)	
Well 61C 1	236
NORTHAMPTON COUNTY	
Well 62G 15 SOW 121	237
Well 63F 15 SOW 105A	238
Well 63F 16 SOW 105C	239
Well 63F 17 SOW 105B	240
Well 63F 34.....	241
Well 63F 51 SOW 182A	242
Well 63F 52 SOW 182B	243
Well 63F 53 SOW 182C	244

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

	Page
NORTHAMPTON COUNTY--Continued	
Well 63F 54 SOW 182D	245
Well 63F 55 SOW 182E	246
Well 63G 15 SOW 104C	247
Well 63G 16 SOW 104B	248
Well 63G 17 SOW 104A	249
Well 63G 22 SOW 111A	250
Well 63G 23 SOW 111B	251
Well 63G 25 SOW 111S	252
Well 63H 4 SOW 103C	253
Well 63H 5 SOW 103B	254
Well 63H 6 SOW 103A	255
Well 63J 1 SOW 113A	256
Well 63J 2 SOW 113B	257
Well 63J 3 SOW 113C	258
Well 64J 9 SOW 112A	259
Well 64J 10 SOW 112B	260
Well 64J 11 SOW 112C	261
ORANGE COUNTY	
Well 45P 1 SOW 030	262
PATRICK COUNTY	
Well 30C 1 SOW 010	263
PORTSMOUTH (INDEPENDENT CITY)	
Well 60C 7	264
Well 60C 27	265
Well 60D 2	266
PRINCE GEORGE COUNTY	
Well 52E 2	267
Well 52F 1 SOW 038	268
PRINCE WILLIAM COUNTY	
Well 49U 1	269
Well 49V 1	270
Well 51S 7	271
Well 52S 4	272
Well 53T 2 SOW 029	273
PULASKI COUNTY	
Well 25E 1 SOW 009	274
Well 25E 2 SOW 059	275
RICHMOND COUNTY	
Well 57M 4	276
ROANOKE (INDEPENDENT CITY)	
Well 31G 1 SOW 008	277
ROCKBRIDGE COUNTY	
Well 35K 1 SOW 063	278
ROCKINGHAM COUNTY	
Well 41Q 1	279
SOUTHAMPTON COUNTY	
Well 51B 3	280
Well 52A 1	281
Well 52B 8 SOW 178A	282
Well 52B 11 SOW 178D	283
Well 52B 12 SOW 178E	284
Well 52B 13 SOW 178F	285
Well 53B 6	286
Well 53B 7	287
Well 54A 1	288
Well 55A 3 SOW 086	289
Well 55C 3	290
Well 55C 10	291

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

	Page
SUFFOLK (INDEPENDENT CITY)	
Well 56A 10 SOW 088A	292
Well 56A 11 SOW 089	293
Well 56A 12 SOW 088B	294
Well 56A 13 SOW 076B	295
Well 56A 14 SOW 076C	296
Well 57B 8	297
Well 57C 21 SOW 099A	298
Well 57C 22 SOW 099B	299
Well 57C 24 SOW 099D	300
Well 58A 75 SOW 170	301
Well 58A 77 SOW 180A	302
Well 58A 78 SOW 180B	303
Well 58A 79 SOW 180C	304
Well 58A 80 SOW 180D	305
Well 58A 81 SOW 180E	306
Well 58A 83 SOW 180G	307
Well 58A 84 SOW 180H	308
Well 58B 13	309
Well 58B268 SOW 169A	310
Well 58B269 SOW 169B	311
Well 58B270 SOW 169C	312
Well 58B273 SOW 169F	313
Well 58C 57 SOW 141A	314
Well 58C 58 SOW 141B	315
Well 58C 59 SOW 141C	316
Well 58C 60 SOW 141D	317
Well 58C 61 SOW 159A	318
Well 58C 62 SOW 159B	319
SURRY COUNTY	
Well 56F 2 SOW 039	320
Well 57E 11 SOW 094A	321
Well 57E 13 SOW 094C	322
Well 57F 16 SOW 087A	323
Well 57F 24 SOW 087B	324
SUSSEX COUNTY	
Well 53D 6 SOW 179A	325
Well 53D 10 SOW 179E	326
Well 53D 11 SOW 179F	327
Well 53E 5 SOW 045	328
VIRGINIA BEACH (INDEPENDENT CITY)	
Well 61C 27 SOW 174A	329
Well 61C 28 SOW 174B	330
Well 61C 43	331
Well 61C 44	332
Well 61C 45	333
Well 61C 46	334
Well 61D 5 SOW 155	335
Well 61D 6 SOW 124	336
Well 61D 9	337
Well 62A 2 SOW 097A	338
Well 62A 3 SOW 097B	339
Well 62A 5	340
Well 62A 22	341
Well 62A 23	342
Well 62B 1 SOW 098A	343
Well 62B 2 SOW 098B	344
Well 62B 8	345
Well 62B 9	346
Well 62B 15	347
Well 62B 16	348
Well 62B 18	349
Well 62B 21	350
Well 62B 22	351
Well 62B 23	352
Well 62B 24	353

GROUND-WATER WELLS, BY COUNTY OR INDEPENDENT CITY, FOR WHICH RECORDS
ARE PUBLISHED IN THIS VOLUME

	Page
VIRGINIA BEACH (INDEPENDENT CITY)--Continued	
Well 62C 2 SOW 092A.....	354
Well 62C 3 SOW 092B.....	355
Well 62C 5 SOW 093.....	356
Well 62C 8 SOW 127.....	357
Well 62C 9 SOW 172A.....	358
Well 62C 10 SOW 172B.....	359
Well 62C 11 SOW 172C.....	360
Well 62C 12 SOW 172D.....	361
Well 62C 15.....	362
Well 62C 24.....	363
Well 62C 32.....	364
Well 62C 33.....	365
Well 62C 34.....	366
Well 63C 2 SOW 100B.....	367
Well 63C 3 SOW 100C.....	368
Well 63C 4 SOW 173A.....	369
Well 63C 5 SOW 173B.....	370
Well 63C 11.....	371
Well 63C 13.....	372
Well 63C 19.....	373
Well 63C 20.....	374
WESTMORELAND COUNTY	
Well 55P 5.....	375
Well 55P 9.....	376
Well 56N 1 SOW 016.....	377
WINCHESTER (INDEPENDENT CITY)	
Well 45X 7.....	378
Well 45X 8.....	379
YORK COUNTY	
Well 57G 17 SOW 068.....	380
Well 58F 62 SOW 187A.....	381
Well 58F 63 SOW 187B.....	382
Well 58F 65 SOW 191A.....	383
Well 59F 1 SOW 027.....	384
Well 59F 72 SOW 184A.....	385
Well 59F 73 SOW 184B.....	386
Well 59F 74 SOW 184C.....	387
Well 59F 81 SOW 186A.....	388
Well 59F 86 SOW 188A.....	389
Well 59F 89 SOW 189A.....	390
Well 59F 96 SOW 189B.....	391
Well 59F 99 SOW 190B.....	392
Quality of ground water.....	393
Miscellaneous quality of ground water.....	394

VOLUME 2. GROUND-WATER-LEVEL AND GROUND-WATER-QUALITY RECORDS

INTRODUCTION

The Water Resources Division of the U.S. Geological Survey (USGS), in cooperation with State agencies, obtains a large amount of data pertaining to the water resources of Virginia each water year. These data, accumulated during many water years, constitute a valuable data base for developing an improved understanding of the water resources of the State. To make these data readily available to interested parties outside the Geological Survey, the data are published annually in this report series entitled "Water Resources Data - Virginia.

This series of annual reports for Virginia began with the 1961 water year with a report that contained only data relating to the quantities of surface water. For the 1964 water year, a similar report was introduced that contained only data relating to water quality. Beginning with the 1975 water year, the report format was changed to present, in one volume, data on quantities of surface water, quality of surface and ground water, and ground-water levels. Beginning with the 1990 water year, the quantity of data to be published made it necessary to present the data in two volumes; Volume 1 encompassed surface-water-discharge and surface-water-quality records and Volume 2 encompassed ground-water-level and ground-water-quality records.

This report is Volume 2 in our 2004 series and includes records of water levels and water quality of ground-water wells. It contains records for water levels at 346 observation wells and water quality at 40 wells. Locations of these wells are shown on figures 4 through 9. The data in this report represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia.

Prior to introduction of this series and for several water years concurrent with it, water-resources data for Virginia were published in U.S. Geological Survey Water-Supply Papers. Data on water levels for the 1935 through 1974 water years were published under the title "Ground-Water Levels in the United States." These Water-Supply Papers may be consulted in the libraries of the principal cities of the United States and may be purchased from U.S. Geological Survey, Branch of Information Services, Federal Center, Bldg. 41, Box 25286, Denver, CO 80225.

Publications similar to this report are published annually by the Geological Survey for all States. These official Survey reports have an identification number consisting of the two-letter State abbreviation, the last two digits of the water year, and the volume number. For example, this volume is identified as "U.S. Geological Survey Water-Data Report VA-03-2." For archiving and general distribution, the reports for 1971-74 water years also are identified as water-data reports. These water-data reports are for sale in paper copy or in microfiche by the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.

Additional information, including current prices, for ordering specific reports may be obtained from the District Office at the address given on the back of the title page or by telephone (804) 261-2600.

Water resources data, including those provided in water data reports, are available through the World Wide Web on the Internet. The Universal Resource Location (URL) to the Virginia District's home page is:

<http://va.water.usgs.gov>

COOPERATION

The U.S. Geological Survey and agencies of the State of Virginia have had joint-funding agreements for the collection of water-resource records since 1930. Organizations that assisted in collecting the data in this report through joint-funding agreements with the Survey are:

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY, Robert G. Burnley, Executive Director.

CITY OF NEWPORT NEWS, Brian Ramaley, Director, Department of Public Utilities.

HAMPTON ROADS PLANNING DISTRICT COMMISSION, Arthur L. Collins, Executive Director.

Organizations that provided data are acknowledged in station descriptions.

RECORDS COLLECTED BY THE STATE OF VIRGINIA

In addition to data collected by the U.S. Geological Survey, there are included herein records for 185 observation wells operated by the Virginia Department of Environmental Quality. These records are published as provided and are acknowledged in the "REMARKS" paragraph of each individual well. The Virginia Department of Environmental Quality is under the direction of Robert G. Burnley, Executive Director. Published material for the ground-water wells is supplied through the Division of Water Resources, Terry D. Wagner, Director.

SUMMARY OF HYDROLOGIC CONDITIONS

Water year 2004 was wetter than normal in Virginia. Precipitation varied across the State and there were dry months but the remnants of four hurricanes (Charley, Frances, Ivan, and Jeanne) and one tropical storm (Gaston) caused heavy rains and floods in August and September 2004 that left few areas of Virginia unaffected.

Changes in ground-water levels during the 2004 water year are illustrated by hydrographs of end-of-month measurements from a network of 12 observation wells in Virginia. Ten of the wells are in water-table aquifers (fig. 1) and two are in confined aquifers of the Coastal Plain (fig. 2). The wells were selected to represent general water-level conditions across the State from different physiographic regions. The physiographic regions of Virginia range from the Cumberland Plateau of the Appalachian Province (coal fields) in the west, to the Valley and Ridge, Blue Ridge, Mesozoic Basins, and Piedmont, in the center of the State, to the Coastal Plain in the east (fig. 4). Water levels in other observation wells documented in this report can differ from those in the selected wells because of differences in well construction (in particular, the diameter and the depth of the open interval of the well), differences in the time interval chosen to measure or to represent the data, or because of local differences in hydrologic conditions.

The water-table aquifers respond to changes in rates of ground-water recharge, flow, and discharge. These processes generally are controlled by natural factors but may also be affected by human activities. The ten network wells in water-table aquifers generally are in areas that are not influenced by pumping. Changes in water levels in the two network wells in the confined aquifers of the Coastal Plain, however, are caused primarily by ground-water pumping. The locations of the selected network wells and other observation wells documented in this report are shown in figures 4 through 9.

Water-Table Aquifer

The water-table aquifers are the shallowest aquifers in Virginia and are present throughout the State. They are formed in different geologic materials at different locations. Water levels in the aquifers respond to changes in rates of recharge and evapotranspiration, but the response time depends on antecedent conditions of the unsaturated zone, on the depth of the water table below land surface, the depth of the open interval of the well, and on the materials above the open interval.

Ground-water recharge requires more liquid water than soil and vegetation can hold. In Virginia, ground-water levels generally rise in the winter and early spring after a rainfall or after ice and snow has thawed. Trees and other plants are dormant then and evapotranspiration is low or nil. Ground-water levels will begin to decline after the opening of leaves in March and April, when rates of evapotranspiration increase. Water levels normally continue to decline throughout the summer to seasonal lows in the late summer and early fall when evapotranspiration is high and soil moisture can become depleted. The resulting dry soil will retain much of the precipitation that falls during these periods, thereby limiting recharge to the water-table aquifer. Consequently, water levels are lowest from late summer to early winter in a normal year.

End-of-month water levels for each network well were plotted against average, minimum, and maximum water levels from each well's period of record (fig. 1). The hydrographs indicate variations during water year 2004 from the typical seasonal cycles and record extremes.

At the beginning of the water year, water levels in all of the water-table wells were above the normal monthly averages with one exception - observation well 45N1 in Louisa County in the central region of the State had below average water levels in October (2003). Three wells in northern Virginia - 46W175, 41Q1, and 55P9 - began the year with record high water levels for October.

Most water levels in the wells were above average or near average for the entire year. Water levels in the Louisa County well, however, were below average for the entire water year. Water levels in one other well - 51G1 in Colonial Heights, also in the central region of the State - dropped below average in the spring. Water levels in that well, however, rose through the summer and reached record levels for the month of August. Water levels in all of the wells ended the water year above the monthly average, with the single exception of the Louisa County well.

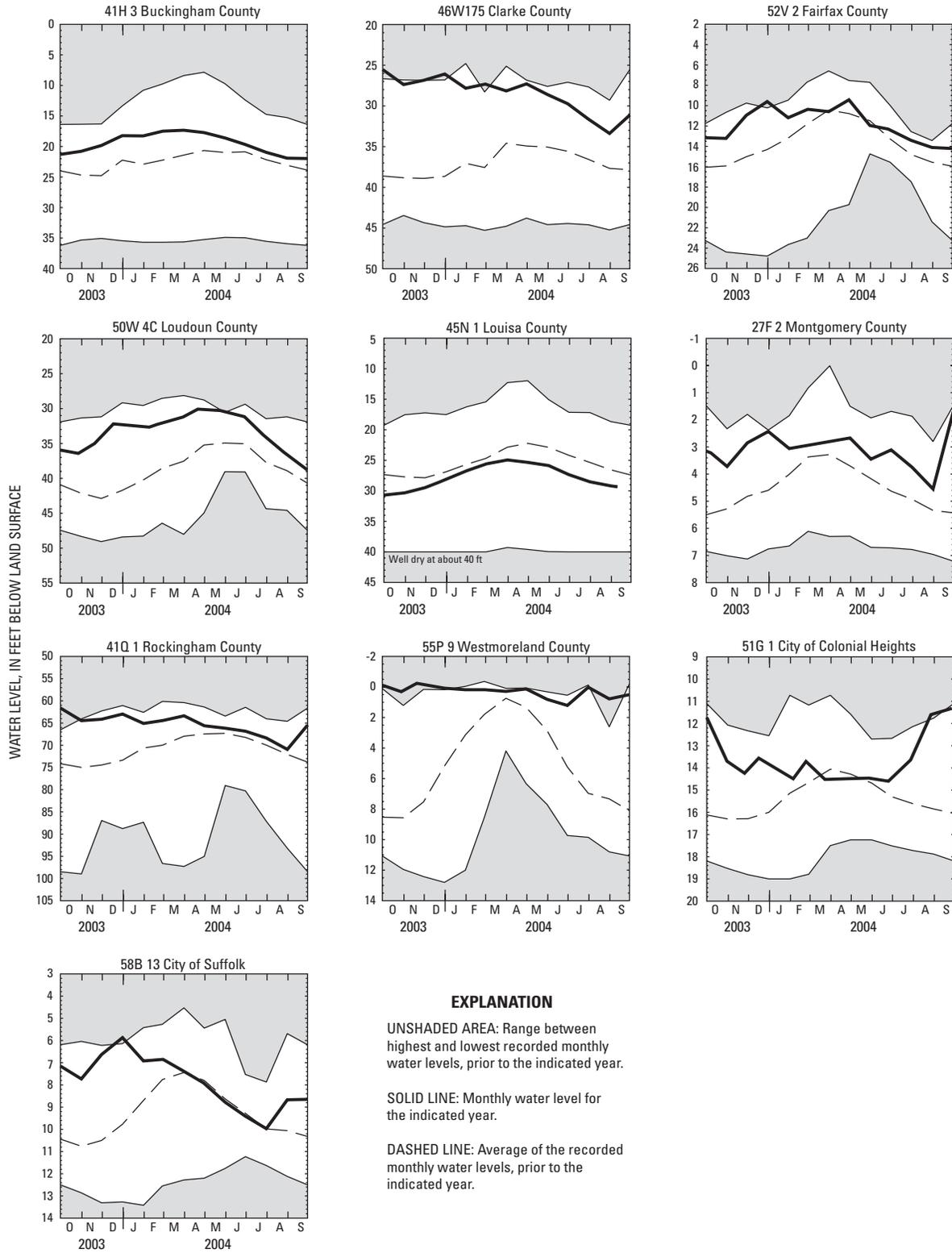


Figure 1. Monthly ground-water levels at index observation wells in water-table aquifers.

Confined Coastal Plain Aquifers

The Coastal Plain of Virginia is in the eastern part of the State (fig. 4) and is underlain by a system of sandy aquifers separated by silty and clayey confining units. These aquifers are laterally continuous throughout the Coastal Plain of Virginia and extend into adjacent states. The confined aquifers are among the highest water-yielding aquifers in Virginia. Consequently, large amounts of water are withdrawn by industrial, municipal, agricultural, and domestic users. The Coastal Plain aquifer system increases in thickness toward the east.

Because of the lateral continuity of these aquifers, declines in water levels that result from pumping can extend over large areas. The magnitude of the decline in a particular well depends on the hydraulic properties of the aquifers and confining units, the amount of water pumped, and the proximity of the well to the pumps. Consequently, water levels in wells indicate the combined effects of regional declines from pumping throughout the aquifer system and local declines from nearby pumps.

In the early 1900's, prior to significant pumping from the confined aquifers, water levels throughout the Coastal Plain were above sea level and likely were near land surface. In the eastern part of the Coastal Plain, water flowed from many wells at land surface. Water levels have declined in the Coastal Plain from the time that pumping began. This regional decline has been well documented in numerous data and interpretive reports.

Water levels in the two network wells (wells 55B16 in Isle of Wight County and 56H27 in James City County) indicate the history of the more recent changes in water levels. Well 55B16 is open to the middle Potomac aquifer. The small, short-term changes in water levels in this well likely result from changes in local pumping (fig. 2). Water levels were likely near land surface prior to pumping and therefore the overall decline in water levels was probably about 100 ft at this location before 1960 when water levels were first measured in this well. Water levels in this well have declined an additional 100 ft since then, mostly during the 1960s. For one month in 1970, and again in 1974, water levels rose significantly in the well because of industrial shutdowns at Franklin, Virginia. When the pumping resumed, the water levels fell back to pumping levels. More recently, water levels generally changed less than earlier water levels, with the exception of September 1999 when torrential rain from Hurricane Floyd caused flooding and the shutdown of industrial wells at Franklin, Virginia. Water levels in the well during water year 2004 generally were similar or slightly lower than those in water year 2003.

Well 56H27 is open to the Brightseat-upper Potomac aquifer. Because water levels are measured infrequently in this well, the influence of local pumping on water levels in this well is not readily evident. The land surface altitude at this well is about 100 ft above sea level and water levels at this location likely declined 50 to 100 ft before 1985 when water levels were first measured (fig. 2). Water levels in this well have declined more than 26 ft since 1985. Water levels in well 56H27 continued to decline in water year 2004, establishing a record new low during the measurement of the water year in July.

EXPLANATION OF THE RECORDS

The ground-water records published in this report are for the 2004 water year that began October 1, 2003, and ended September 30, 2004. A calendar of the water year is provided on the inside of the front cover. The records contain ground-water-level and ground-water-quality data. The locations of the wells where the water-level data were collected are shown in figures 4 through 9. The following sections of the introductory text are presented to provide users with a more detailed explanation of how the hydrologic data published in this report were collected, analyzed, computed, and arranged for presentation.

Station Identification Numbers

Each well in this report is assigned a unique identification number. This number is unique in that it applies specifically to a given well and to no other. The number usually is assigned when a well is first established in U.S. Geological Survey records and is retained for that well indefinitely. The system used by the U.S. Geological Survey to assign identification numbers for ground-water well sites is based on geographic location. The "latitude-longitude" system is used for wells.

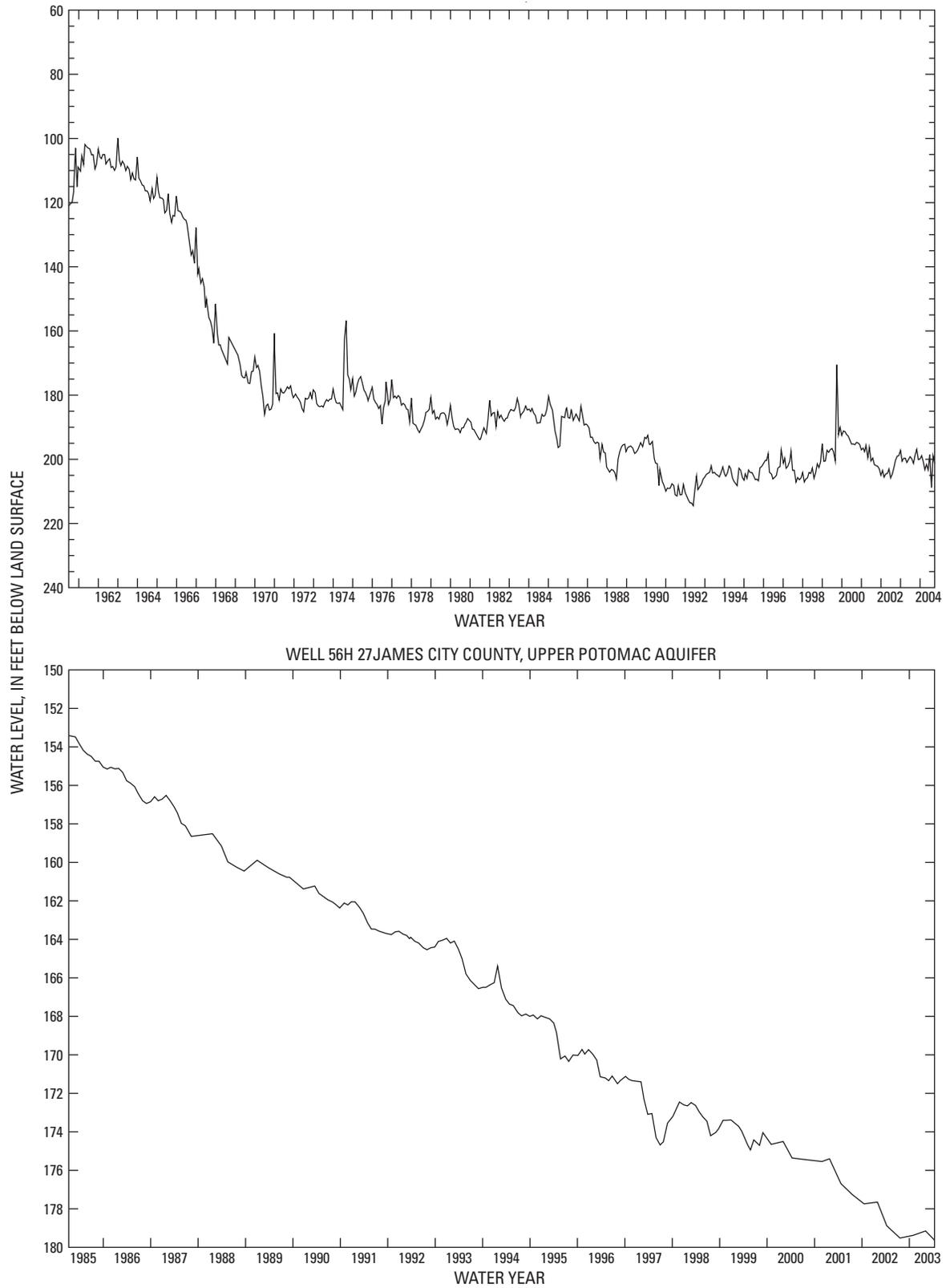


Figure 2. Ground-water levels in selected observation wells in confined Coastal Plain aquifers.

Latitude-Longitude System

The identification numbers for wells are assigned according to the grid system of latitude and longitude. The number consists of 15 digits. The first six digits denote the degrees, minutes, and seconds of latitude, the next seven digits denote degrees, minutes, and seconds of longitude, and the last two digits (assigned sequentially) identify the wells or other sites within a 1-second grid. This site-identification number, once assigned, is a pure number and has no locational significance. In the rare instance where the initial determination of latitude and longitude are found to be in error, the station will retain its initial identification number; however, its true latitude and longitude will be listed in the LOCATION paragraph of the station description.

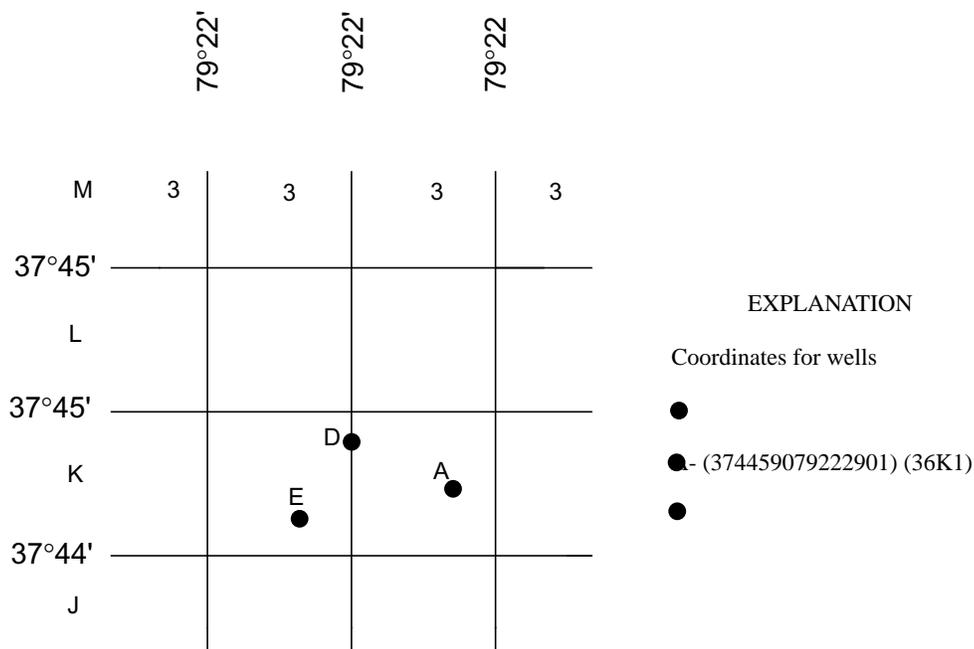


Figure 3. System for numbering wells.

A second well-numbering system used in Virginia utilizes 7 1/2-minute quadrangles within the State. The quadrangles are numbered from west to east, and lettered from south to north, omitting the letters "I" and "O." The designation for each quadrangle is determined by the method "Read Right, Up." Wells are numbered serially within each quadrangle. This local well number is shown immediately after the primary well number.

Well records furnished by the State of Virginia also include the well number that is based on an indexing system used by the Virginia Department of Environmental Quality.

Records of Ground-Water Levels

Only water-level data from a national network of observation wells are given in this report. These data are intended to provide a sampling and historical record of water-level changes in the Nation's most important aquifers. Locations of the observation wells in this network in Virginia are shown in figures 4 through 9.

Data Collection and Computation

Measurements of water levels are made in many types of wells under varying conditions, but the methods of measurement are standardized to the extent possible. The equipment and measuring techniques used at each observation well ensure that measurements at each well are of consistent accuracy and reliability.

Tables of water-level data are presented by counties arranged in alphabetical order. The prime identification number for a given well is the 15-digit number that appears in the upper left corner of the table. The secondary identification number is the local well number, an alphanumeric number, derived from the township-range location of the well.

Water-level data are obtained from direct measurements with a steel tape or manometer, or from graphic, punched tape, or electronic water-stage recorder. The water-level measurements in this report are given in feet with reference to land-surface datum (lsd). Land-surface datum is a datum plane that is approximately at land surface at each well. If known, the elevation of the land-surface datum is given in the well description. The height of the measuring point (MP) above or below land-surface datum is given in each well description. Water levels in wells equipped with recording gages are reported for every fifth day and the end of each month (eom).

Water levels are reported to as many significant figures as can be justified by the local conditions. For example, in a measurement of a depth to water of several hundred feet, the error of determining the absolute value of the total depth to water may be a few tenths of a foot, whereas the error in determining the net change of water level between successive measurements may be only a hundredth or a few hundredths of a foot. For lesser depths to water, the accuracy is greater. Accordingly, most measurements are reported to a hundredth of a foot, but some are given to a tenth of a foot or a larger unit.

Data Presentation

Each well record consists of three parts, the station description, the data table of water levels observed during the current water year, and a graph of the water levels for the current water year or other selected period. The description of the well is presented first through use of descriptive headings preceding the tabular data. The comments to follow clarify information presented under the various headings.

LOCATION.--This paragraph follows the well-identification number and reports the latitude and longitude (given in degrees, minutes, and seconds); a landline location designation; the hydrologic-unit number; the distance and direction from a geographic point of reference; and the owner's name.

AQUIFER.--This entry designates by name (if a name exists) and geologic age the aquifer(s) open to the well.

WELL CHARACTERISTICS.--This entry describes the well in terms of depth, diameter, casing depth and/or screened interval, method of construction, use, and additional information such as casing breaks, collapsed screen, and other changes since construction.

INSTRUMENTATION.--This paragraph provides information on both the frequency of measurement and the collection method used, allowing the user to better evaluate the reported water-level extremes by knowing whether they are based on weekly, monthly, or some other frequency of measurement.

DATUM.--This entry describes both the measuring point and the land-surface elevation at the well. The measuring point is described physically (such as top of collar, notch in top of casing, plug in pump base and so on), and in relation to land surface (such as 1.3 ft above land-surface datum). The elevation of the land-surface datum is described in feet above (or below) sea level; it is reported with a precision depending on the method of determination.

REMARKS.--This entry describes factors that may influence the water level in a well or the measurement of the water level. It should identify wells that also are water-quality observation wells, and may be used to acknowledge the assistance of local (non-Survey) observers.

PERIOD OF RECORD.--This entry indicates the period for which there are published records for the well. It reports the month and year of the start of publication of water-level records by the U.S. Geological Survey and the words "to current year" if the records are to be continued into the following year. Periods for which water-level records are available, but are not published by the Geological Survey, may be noted.

EXTREMES FOR PERIOD OF RECORD.--This entry contains the highest and lowest water levels of the period of published record, with respect to land-surface datum, and the dates of their occurrence.

EXTREMES FOR CURRENT YEAR.--This entry contains the highest and lowest instantaneous water levels, along with the dates of occurrence, at sites with water-stage recorders. The values are for the current water year, and are with respect to land-surface datum.

A table of water levels follows the station description for each well. Water levels are reported in feet below land-surface datum and all taped measurements of water level are listed. For wells equipped with recorders, only abbreviated tables are published; generally, only water-level lows are listed for every fifth day and at the end of the month (eom). The highest and lowest water levels of the water year and their dates of occurrence are shown on a line below the abbreviated table. Because all values are not published for wells with recorders, the extremes may be values that are not listed in the table. Missing records are indicated by dashes in place of the water level. A hydrograph for a selected period of record follows each water-level table.

Records of Ground-Water Quality

Records of ground-water quality in this report differ from other types of records in that, for most sampling sites, they consist of only one set of measurements for the water year. The quality of ground water ordinarily changes only slowly; therefore, for most general purposes, one annual sampling, or only a few samples taken at infrequent intervals during the year, is sufficient. Frequent measurement of the same constituents is not necessary unless one is concerned with a particular problem, such as monitoring for trends in nitrate concentration. In the special cases where the quality of ground water may change more rapidly, more frequent measurements are made to identify the nature of the changes.

Data Collection and Computation

The records of ground-water quality in this report were obtained mostly as a part of special studies in specific areas. Consequently, a number of chemical analyses are presented for some counties but none are presented for others. As a result, the records for this year, by themselves, do not provide a balanced view of ground-water quality Statewide. Such a view can be attained only by considering records for this year in context with similar records obtained for these and other counties in earlier years.

Most methods for collecting and analyzing water samples are described in the "U.S. Geological Survey Techniques of Water-Resources Investigations" publications referred to in the "On-site Measurements and Sample Collection" and the "Laboratory Measurements" sections in this data report. In addition, the TWRI book 1, Chapter D2, describes guidelines for the collection and field analysis of ground-water samples for selected unstable constituents, and may be accessed from <http://water.usgs.gov/pubs/twri/>. The values reported in this report represent water-quality conditions at the time of sampling as much as possible, consistent with available sampling techniques and methods of analysis. These methods are consistent with the American Society for Testing and Materials (ASTM) standards and generally follow the standards of the International Organization for Standardization (ISO). All samples were obtained by trained personnel. The wells sampled were pumped long enough to assure that the water collected came directly from the aquifer and had not stood for a long time in the well casing where it would have been exposed to the atmosphere and to the material, possibly metal, comprising the casings.

Data Presentation

The records of ground-water quality are published in a section titled QUALITY OF GROUND WATER immediately following the ground-water-level records. Data for quality of ground water are listed alphabetically by County and are identified by well number. The prime identification number for wells sampled is the 15-digit number derived from the latitude-longitude locations. No descriptive statements are given for ground-water-quality records; however, the well number, depth of well, date of sampling, and other pertinent data are given in the table containing the chemical analyses of the ground water.

Remark Codes

The following remark codes may appear with the ground-water-quality data in this report:

PRINTED OUTPUT	REMARK
E	Estimated value
>	Actual value is known to be greater than the value shown
<	Actual value is known to be less than the value shown
K	Results based on colony count outside the acceptance range (non-ideal colony count)
L	Biological organism count less than 0.5 percent (organism may be observed rather than counted)
D	Biological organism count equal to or greater than 15 percent (dominant)
V	Analyte was detected in both the environmental sample and the associated blanks.
&	Biological organism estimated as dominant
M	Constituent was detected but not quantified.

Water Quality-Control Data

Data generated from quality-control (QC) samples are a requisite for evaluating the quality of the sampling and processing techniques as well as data from the actual samples themselves. Without QC data, environmental sample data cannot be adequately interpreted because the errors associated with the sample data are unknown. The various types of QC samples collected by this district are described in the following section. Procedures have been established for the storage of water-quality-control data within the USGS. These procedures allow for storage of all derived QC data and are identified so that they can be related to corresponding environmental samples.

Blank Samples

Blank samples are collected and analyzed to ensure that environmental samples have not been contaminated by the overall data-collection process. The blank solution used to develop specific types of blank samples is a solution that is free of the analytes of interest. Any measured value signal in a blank sample for an analyte (a specific component measured in a chemical analysis) that was absent in the blank solution is believed to be due to contamination. There are many types of blank samples possible, each designed to segregate a different part of the overall data-collection process. The types of blank samples collect in this district are:

Source solution blank - a blank solution that is transferred to a sample bottle in an area of the office laboratory with an atmosphere that is relatively clean and protected with respect to target analytes.

Ambient blank - a blank solution that is put in the same type of bottle used for an environmental sample, kept with the set of sample bottles before sample collection, and opened at the site and exposed to the ambient conditions.

Field blank - a blank solution that is subjected to all aspects of sample collection, field processing preservation, transportation, and laboratory handling as an environmental sample.

Trip blank - a blank solution that is put in the same type of bottle used for an environmental sample and kept with the set of sample bottles before and after sample collection.

Equipment blank - a blank solution that is processed through all equipment used for collecting and processing an environmental sample (similar to a field blank but normally done in the more controlled conditions of the office).

Sampler blank - a blank solution that is poured or pumped through the same field sampler used for collecting an environmental sample.

Pump blank - a blank solution that is processed through the same pump-and-tubing system used for an environmental sample.

Standpipe blank - a blank solution that is poured from the containment vessel (stand-pipe) before the pump is inserted to obtain the pump blank.

Filter blank - a blank solution that is filtered in the same manner and through the same filter apparatus used for an environmental sample.

Splitter blank - a blank solution that is mixed and separated using a field splitter in the same manner and through the same apparatus used for an environmental sample.

Preservation blank - a blank solution that is treated with the sampler preservatives used for an environmental sample.

Canister blank - a blank solution that is taken directly from a stainless steel canister just before the VOC sampler is submerged to obtain a field blank sample.

Reference Samples

Reference material is a solution or material prepared by a laboratory whose composition is certified for one or more properties so that it can be used to assess a measurement method. Samples of reference material are submitted for analysis to ensure that an analytical method is accurate for the known properties of the reference material. Generally, the selected reference material properties are similar to the environmental sample properties.

Replicate Samples

Replicate samples are a set of environmental samples collected in a manner such that the samples are thought to be essentially identical in composition. Replicate is the general case for which a duplicate is the special case consisting of two samples. Replicate samples are collected and analyzed to establish the amount of variability in the data contributed by some part of the collection and analytical process. There are many types of replicate samples possible, each of which may yield slightly different results in a dynamic hydrologic setting, such as a flowing stream. The types of replicate samples collected in this district are:

Concurrent sample - a type of replicate sample in which the samples are collected simultaneously with two or more samplers or by using one sampler and alternating collection of samples into two or more compositing containers.

Sequential samples - a type of replicate sample in which the samples are collected one after the other, typically over a short time.

Split sample - a type of replicate sample in which a sample is split into subsamples contemporaneous in time and space.

Spike Samples

Spike samples are samples to which known quantities of a solution with one or more well-established analyte concentrations have been added. These samples are analyzed to determine the extent of matrix interference or degradation on the analyte concentration during sample processing and analysis.

Concurrent sample - a type of spike sample that is collected at the same time with the same sampling and compositing devices then spiked with the same spike solution containing laboratory-certified concentrations of selected analytes.

Split sample - a type of spike sample in which a sample is split into subsamples contemporaneous in time and space then spiked with the same spike solution containing laboratory-certified concentrations of selected analytes.

ACCESS TO USGS WATER DATA

The USGS provides near real-time stage and discharge data for many of the gaging stations equipped with the necessary telemetry and historic daily-mean and peak-flow discharge data for most current or discontinued gaging stations through the world wide web (WWW). These data may be accessed at:

<http://va.water.usgs.gov>

Some water-quality and ground-water data also are available through the WWW. In addition, data can be provided in various machine-readable formats on magnetic tape or 3-1/2 inch floppy disk. Information about the availability of specific types of data or products, and user charges, can be obtained locally from each of the Water Resources Division District Offices (See address on the back of the title page.)