Status of water-level network, Elbert County Colorado, September, 2016

By Rhett R. Everett

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

Contents

Abbreviations

ARAP	Well completed in the Arapahoe aquifer
ARAPMAS	Well completed in the Arapahoe aquifer
CDWR	Colorado Division of Water Resources
DAWMAS	Well completed in the Dawson (upper of lower) aquifer
DENV	Well completed in the Denver aquifer
LARA	Well completed in the Laramie Fox-Hills aquifer
LDAW	Well completed in the lower Dawson aquifer
NAWQA	National Water-Quality Assessment
NWIS	National Water Information System
NWISWeb	National Water Information System Web interface
UDAW	Well completed in the upper Dawson aquifer
USGS	U.S. Geological Survey

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Project Status -Overview

- The project is progressing as scheduled and on budget.
- Started soliciting volunteers and measuring water levels in January 2015. Completed in April 2015.
- Currently 41 wells in the network (11 upper Dawson, 10 lower Dawson, 6 Denver, 9 Arapahoe, 5 Laramie Fox Hills) *contract with CWCB states 30 wells will be monitored!
- Water levels are measured bi-monthly (February, April, June, August, October, and December)
- Water levels are measured to the 100th of a foot
- To date (9/29/16) 486 manual water-level measurements have been made for this project
- Transducers are currently installed in 6 wells, (2 upper Dawson, 2 lower Dawson, 1 Denver, 0 Arapahoe, 1 Laramie Fox Hills)
- To date (9/29/16) more than 52,000 automated readings have been collected
- GPS Survey of well head elevation scheduled to be completed early spring of 2017
- Water level data is available on the USGS web site http://nwis.waterdata.usgs.gov/nwis See NWIS Web section at the end of the report

Project Status -Detail

Project activities are progressing as scheduled and on budget. Soliciting well owners began in January 2015 and was completed in April 2015. Fourth-two wells were selected for the network (11 upper Dawson, 10 lower Dawson, 7 Denver, 9 Arapahoe, and 5 Laramie Fox Hills) (fig. 1). In August 2016, one Denver well (DENV 13) was dropped from the network when the residence was sold and the new owner declined to continue participation in the study.

Water level measurements began in February 2015 and have been measured bi-monthly since. To date (9/29/16) 486 manual water-level measurements have been made for this project. Pressure transducer instrumentation is installed in six wells (2 upper Dawson, 2 lower Dawson, 1 Denver, 0 Arapahoe, and 1 Laramie Fox Hills) (fig. 1). The first transducer was installed in August 2015; the last transducer was installed in February 2016. The pressure transducers automatically record an hourly water level measurement. To date (9/29/16) more than 52,000 automated readings have been collected. Water level data collection is scheduled to continue through February 2018All water level measurements are made available to the public on the USGS National Water Information System (NWIS) web site at http://nwis.waterdata.usgs.gov/nwis.

Twelve of the wells in the network have water levels previously measures by the USGS, most in 2004/2005. A comparison of the water levels measured in 2004/2005 with those measured in April 2015 show no per annum change in water level in the upper Dawson wells, a rise of 0.7 ft/year in the lower Dawson wells, a decline of 3.1 ft/year in the Denver wells, a decline of 0.3 ft/year in the Arapahoe wells, and a decline of 0.6 ft/year in the Laramie-Fox Hills wells (table 1).

All of the wells in the network have water levels reported on the Well Completion and Pump Installation Report ("driller's logs") submitted to the State by the driller or pump installer immediately after the well was constructed. In some cases, the driller's depth to water may be estimated, as the

values are reported to the tens of feet; this could introduce error into the calculated change when compared with water levels measured to the hundredth of a foot. However, a comparison of water levels reported on driller's logs with the initial manual water level measured by USGS show a decline of 0.5 ft/year in the upper Dawson wells, a rise of 2.0 ft/year in the lower Dawson wells, a decline of 0.3 ft/year in the Denver wells, a decline of 0.2 ft/year in the Arapahoe, and a rise of 0.8 ft/year in the Laramie-Fox Hills wells (table 2).

Comparison of all year-to-year changes (2015 to 2016) in manual water-level measurements for all wells show a rise of 0.4 ft in the upper Dawson wells, a decline of 0.7 ft in the lower Dawson wells, a rise of 0.1 ft in the Denver wells, a rise of 0.2 ft in the Arapahoe wells, and a rise of 0.8 ft/year in the Laramie-Fox Hills wells (table 3).

The high-precision GPS survey originally scheduled for the spring of 2016 was delayed. It is scheduled for the spring of 2017.

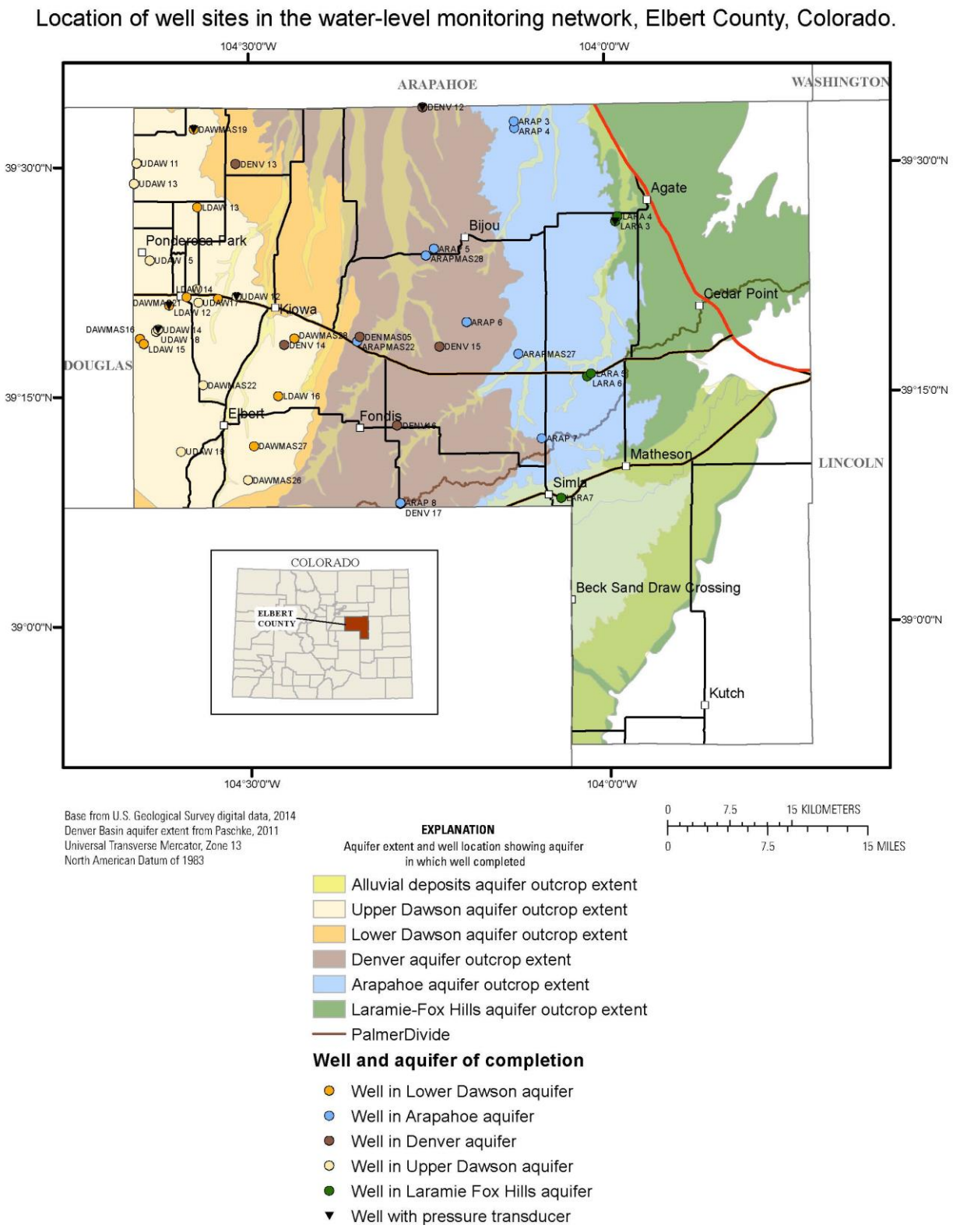

Figure 1. Location of well sites in the water-level monitoring network, Elbert County, Colorado

Table 1: Comparison of historic USGS water levels with measurements from April 2015

Aquifer	Site name	Date	Depth to water (ft)	Date	Depth to water (ft)	Change in water level (ft) (-, decline; +, rise)	Per Annun Change in water level (ft) (-, decline; +, rise)
Upper Dawson	UDAW 17	7/24/1978	187.5	4/9/2015	191.88	-4.38	-0.12
	DAWMAS22	11/22/2004	166.58	4/2/2015	166.47	0.11	0.01
	DAWMAS26	12/7/2004	349.77	4/2/2015	348.79	0.98	0.10
					average:	**-1.1**	**0.0**
Lower Dawson	DAWMAS16	11/17/2004	284.01	4/2/2015	264.08	19.93	1.95
	DAWMAS21	11/16/2004	97.6	4/9/2015	87.29	10.31	1.01
	DAWMAS28	12/14/2004	254.66	4/2/2015	262.17	-7.51	-0.74
					average:	**7.58**	**0.7**
Denver	DENV 16	10/18/1982	82.78	4/9/2015	81.95	0.83	0.03
	DENMAS05	12/29/2005	242.34	4/3/2015	300	-57.66	-6.31
					average:	**-28.42**	**-3.1**
Arapahoe	ARAPMAS22	7/1/2005	310.08	4/3/2015	309.33	0.75	0.08
	ARAPMAS27	7/14/2005	47.97	4/9/2015	57.29	-9.32	-0.97
	ARAPMAS28	7/14/2005	205.01	4/3/2015	205.92	-0.91	-0.09
					average:	**-3.16**	**-0.3**
Laramie Fox-Hills	LARA 7	8/30/1983	119.27	4/9/2015	136.94	-17.67	-0.57
					average:	**-17.67**	**-0.6**

Table 2: Comparison of driller reported water levels with USGS water level measurements from April 2015

	Initial water level (reported by driller)		Water level measured by USGS			
Site name	Date	Depth to water (ft)	Date	Depth to water (ft)	Change in water level (ft) (-, decline; +, rise)	Per Annun Change in water level (ft) (-, decline; +, rise)
UDAW 11	1/24/1989	70	4/10/2015	96	-26	-1.01
UDAW 12	3/1/1970	185	4/9/2015	173	12	0.27
UDAW 13	2/27/1998	150	4/10/2015	164	-14	-0.83
UDAW 14	8/20/1981	186	4/2/2015	184	2	0.06
UDAW 15	10/6/1993	170	4/10/2015	188	-18	-0.85
UDAW 16	4/21/1981	151	4/9/2015	184	-33	-0.99
UDAW 17	2/22/1975	183	4/9/2015	192	-9	-0.23
UDAW 18	9/23/1985	120	2/7/2015	162	-42	-1.45
UDAW 19	3/17/2005	260	4/2/2015	264	-4	-0.40
DAWMAS22 U	11/22/1995	170	4/2/2015	166	4	0.21
DAWMAS26 U	5/18/1994	332	4/2/2015	349	-17	-0.83
				average:	**-13.2**	**-0.5**
LDAW 12	4/21/1992	140	4/2/2015	161	-21	-0.93
LDAW 13	1/13/1998	120	4/10/2015	123	-3	-0.18
LDAW 14	11/10/1994	200	4/9/2015	149	51	2.53
LDAW 15	8/4/1995	200	4/2/2015	198	2	0.10
LDAW 16	4/22/2003	230	4/2/2015	148	82	6.96
DAWMAS16	10/1/1996	380	4/2/2015	264	116	6.36
DAWMAS19	12/4/1993	200	4/10/2015	211	-11	-0.52
DAWMAS21	11/3/1993	190	4/9/2015	87	103	4.87
DAWMAS27	6/13/2001	290	4/2/2015	271	19	1.40
DAWMAS28	6/2/1977	238	4/2/2015	262	-24	-0.64
				average:	**31.4**	**2**
DENV 12	4/23/2007	110	4/3/2015	114	-4	-0.51
DENV 13	3/26/2004	270	4/10/2015	332	-62	-5.69
DENV 14	3/26/2007	320	4/2/2015	240	80	10.12
DENV 15	10/24/1997	50	4/3/2015	143	-93	-5.41
DENV 16	5/16/1961	110	4/9/2015	82	28	0.53
DENV 17	2/18/2000	350	4/9/2015	258	92	6.16
DENMAS05	3/27/1996	165	4/3/2015	300	-135	-7.20
				average:	**-13.4**	**-0.3**

ARAP 3	4/28/2000	110	4/3/2015	108	2	0.14
ARAP 4	12/13/1995	45	4/3/2015	51	-6	-0.32
ARAP 5	2/28/1981	320	4/3/2015	334	-14	-0.42
ARAP 6	11/20/2002	160	4/3/2015	293	-133	-10.90
ARAP 7	5/5/2005	153	4/9/2015	147	6	0.61
ARAP 8	3/11/2013	390	4/9/2015	377	13	6.34
ARAPMAS22	11/16/1998	340	4/3/2015	309	31	1.92
ARAPMAS27	1/28/2004	70	4/9/2015	57	13	1.18
ARAPMAS28	3/8/1996	195	4/3/2015	206	-11	-0.58
				average:	**-11.0**	**-0.2**
LARA 3	9/27/2006	100	4/3/2015	85	15	1.79
LARA 4	11/6/2002	80	4/3/2015	80	0	0.00
LARA 5	11/10/1999	200	4/9/2015	140	60	3.95
LARA 6	10/22/2001	130	4/9/2015	145	-15	-1.13
LARA 7	12/9/1965	108	4/9/2015	137	-29	-0.60
				average:	**6.2**	**0.8**

Table 3: Comparison of water levels Spring 2015 and spring 2016

Site name	Date	Depth to water (ft)	Date	Depth to water (ft)	Change in water level (ft) (-, decline; +, rise)
UDAW 11	1/30/2015	97.17	2/25/2016	95.99	1.18
UDAW 12	1/29/2015	173.48	2/19/2016	172.78	0.7
UDAW 13	3/13/2015	162.85	2/25/2016	163.44	-0.59
UDAW 14	2/7/2015	183.70	2/19/2016	183.34	0.36
UDAW 15	3/13/2015	189.34	2/19/2016	189.06	0.28
UDAW 16	1/18/2015	183.92	2/19/2016	182.05	1.87
UDAW 17	1/29/2015	191.97	2/19/2016	192.30	-0.33
UDAW 18	2/7/2015	162.18	2/19/2016	161.87	0.31
UDAW 19	4/2/2015	263.81	2/15/2016	263.60	0.21
DAWMAS22	2/21/2015	166.13	2/15/2016	166.18	-0.05
DAWMAS26	2/20/2015	348.75	2/15/2016	348.73	0.02
				average:	**0.4**

LDAW 12	3/13/2015	161.73	2/19/2016	166.33	-4.6
LDAW 13	2/21/2015	124.36	2/19/2016	124.77	-0.41
LDAW 14	1/18/2015	149.27	2/19/2016	148.32	0.95
LDAW 15	2/7/2015	203.12	2/15/2016	200.65	2.47
LDAW 16	4/2/2015	147.82	2/15/2016	148.41	-0.59
DAWMAS16	2/21/2015	263.70	2/15/2016	263.40	0.3
DAWMAS19	3/13/2015	211.82	2/25/2016	211.98	-0.16
DAWMAS21	1/31/2015	90.19	2/19/2016	92.09	-1.9
DAWMAS27	3/13/2015	270.46	2/15/2016	270.38	0.1
DAWMAS28	2/9/2015	262.10	2/15/2016	264.85	-2.75
				average:	**-0.7**
DENV 12	3/14/2015	114.18	2/11/2016	114.02	0.2
DENV 13	1/30/2015	334.63	2/19/2016	333.10	1.53
DENV 14	2/9/2015	240.71	2/15/2016	239.08	1.63
DENV 15	3/21/2015	140.94	2/11/2016	139.95	0.99
DENV 16	4/9/2015	81.94	2/25/2016	82.28	-0.34
DENV 17	2/20/2015	259.27	2/12/2016	260.69	-1.42
DENMAS05	3/5/2015	246.21	2/12/2016	248.40	-2.2
				average:	**0.1**
ARAP 3	4/3/2015	107.82	2/11/2016	106.57	1.25
ARAP 4	3/14/2015	51.39	2/11/2016	50.77	0.62
ARAP 5	1/31/2015	334.12	2/11/2016	333.86	0.26
ARAP 6	3/7/2015	292.77	2/11/2016	292.65	0.12
ARAP 7	3/14/2015	146.87	2/12/2016	146.83	0.04
ARAP 8	2/20/2015	377.52	2/12/2016	377.60	-0.08
ARAPMAS22	3/20/2015	309.59	2/12/2016	311.17	-1.58
ARAPMAS27	3/21/2015	57.19	2/12/2016	56.59	0.6
ARAPMAS28	1/31/2015	205.69	2/11/2016	205.61	0.08
				average:	**0.2**
LARA 3	3/5/2015	82.31	2/11/2016	82.11	0.2
LARA 4	4/3/2015	80.25	2/11/2016	75.81	4.44
LARA 5	2/27/2015	140.15	2/12/2016	140.05	0.1
LARA 6	4/9/2015	144.77	2/12/2016	144.58	0.19
LARA 7	3/7/2015	135.81	2/12/2016	136.92	-1.11
				average:	**0.8**

Elbert County Water Use

All data in this section is from Ivahnenko, Tamara, and Flynn, J.L., 2010, Estimated withdrawals and use of water in Colorado, 2005: U.S. Geological Survey Scientific Investigations Report 2010–5002, 61 p.

- A 1,538-mi2 portion of eastern Elbert County is underlain by the Denver Basin aquifer system, and groundwater pumped from the aquifers is the primary source of municipal and domestic water supply.
- Estimated Percentage of the Withdrawal from the Denver Basin in 2005 for Elbert County: 4%
- Estimated Percentage of the Total Withdrawal from the Denver Basin in 2005 for Elbert County: Alluvial- 2%, upper Dawson- 33%, lower Dawson- 14%, Denver- 6%, Arapahoe- 2%, Laramie-Fox Hills- 1%
- Estimated Water Use in 2005 for Elbert County- 29.43 Mgal/d: Public Supply- 20.82 Mgal/day- 71%; Irrigation- 4.24 Mgal/day- 14%; Domestic/Livestock- 3.54 Mgal/day- 12%; Commercial- 0.75 Mgal/day- 3%; Household (domestic)- 0.08 Mgal/day- >1%
- Estimated Water Use in 2005 for Elbert County-29.43 Mgal/d: Alluvial- 8%; upper Dawson- 20%; lower Dawson- 25%; Denver- 27%; Arapahoe- 17%; Laramie-Fox Hills- 4%.

Elbert County Well Permits

- Over 14,600 Permit Events in Elbert County
- Approximately 5,500 events are not valid wells: 461- Outside Elbert County; 461- Outside Elbert County; 557- Abandoned; 2,247 Extended or Unknown; 658- No Status Remarks
- 9,311 Active Wells in Elbert County; 7,249 Domestic; 1,446 Stock; 235 Irrigation; 47 Municipal; 289 "Other"
- 5,096 Wells with Complete Records: 53 Alluvial- 1%; 2,875 upper Dawson- 56%; 550 lower Dawson- 11%; 931 Denver- 18%; 427 Arapahoe- 8%; 260 Laramie-Fox Hills- 5%

Elbert County Water Level Data

- See ElbertCounty_InitialWaterLevels.xls for summary of water level changes
- Began water level measurements in Jan 2015
- 14 of the wells in the current network have water levels previously measures by the USGS, most in 2004/2005
- To date (9/29/16) 486 manual water-level measurements have been made for this project
- For most wells the water level in June 2015 was higher than February 2015- average 0.30 ft higher. This is not typical, water levels usually decline during the summer months.
- All wells have at least one reported water level measured by the driller when the well was drilled
- Pressure transducers with data recorders are installed in 6 wells. They hourly water level measurements will be available on the web in the near future.
- Wells with Water Level Data: Municipal Wells (48), DWR Network (27), USGS (>200)

- Division of Water Resources 2014 Report

  http://dwrweblink.state.co.us/dwrweblink/0/doc/2769958/Electronic.aspx?searchid=f8f4e13a-93f5-431f-b05f-9595af1b69e0
- DWR Report shows between 2009 and 2014 water levels declined in most wells between 0 to 4 feet. Between 2004 and 2014 water levels were mixed; some declined 0 to 4 feet some rose 0 to 4 feet.

NWISWeb

- Water level data (current and historic) is published to the web via the USGS National Water Information System (NWIS) Web interface (NWISWeb).
- Link to site table:

  http://nwis.waterdata.usgs.gov/nwis/inventory?multiple_site_no=393016104392601%2C392133104310201%2C392856104393801%2C391924104374101%2C392355104382001%2C392203104342301%2C392130104341401%2C391915104375001%2C391126104354701%2C391545104335401%2C390935104301001%2C392058104364401%2C392724104341901%2C392125104323701%2C391829104385301%2C391502104273601%2C391852104391301%2C393227104343401%2C392131104351701%2C391148104294101%2C391848104261401%2C393350104151701%2C393012104310701%2C391821104270601%2C391811104140301%2C391257104173601%2C390755104172501%2C391851104204501%2C393251104073701%2C393225104073601%2C392434104142701%2C391946104114501%2C391208104053301%2C390800104172601%2C391834104205601%2C391740104072401%2C392400104150601%2C392616103591001%2C39263510

3590001%2C391621104012001%2C391609104014001%2C390817104040301&format=station_list&group_key=NONE&list_of_search_criteria=multiple_site_no

- Link to hydrographs:

  http://nwis.waterdata.usgs.gov/nwis/gwlevels?multiple_site_no=393016104392601%2C392133104310201%2C392856104393801%2C391924104374101%2C392355104382001%2C392203104342301%2C392130104341401%2C391915104375001%2C391126104354701%2C391545104335401%2C390935104301001%2C392058104364401%2C392724104341901%2C392125104323701%2C391829104385301%2C391502104273601%2C391852104391301%2C393227104343401%2C392131104351701%2C391148104294101%2C391848104261401%2C393350104151701%2C393012104310701%2C391821104270601%2C391811104140301%2C391257104173601%2C390755104172501%2C391851104204501%2C393251104073701%2C393225104073601%2C392434104142701%2C391946104114501%2C391208104053301%2C390800104172601%2C391834104205601%2C391740104072401%2C392400104150601%2C392616103591001%2C392635103590001%2C391621104012001%2C391609104014001%2C390817104040301&group_key=NONE&sitefile_output_format=html_table&column_name=agency_cd&column_name=site_no&column_name=station_nm&format=gif&date_format=YYYY-MM-DD&rdb_compression=file&list_of_search_criteria=multiple_site_no

Publications Relevant to Elbert County

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