

Colorado Division of Water Resources Water Level Monitoring Network High Plains and Colorado Plateaus Principal Aquifers



December 6, 2017

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Helen Malenda, Hydrogeologist
Hydrogeological Services Group



COLORADO

Division of Water Resources

Department of Natural Resources

Colorado Division of Water Resources

- An agency of Department of Natural Resources
- Also known as Office of the State Engineer
 - Administer water rights
 - Issue well permits
 - Represent Colorado in interstate compacts
 - Monitor streamflow, water use, and groundwater
 - Approve construction/repair of dams/dam safety
 - Issue licenses for well drillers, ensure safe and proper construction of wells
 - Maintain databases of Colorado water information

History of Colorado Water

- 1876 - Prior appropriation doctrine adopted at statehood
- 1879 - Water commissioners established to administer irrigation ditches
- 1881 - State Engineer established to measure streamflow and supervise water commissioners



History of Colorado Water

- 1965 - Colorado Ground Water Management Act
 - Ground Water Commission
 - Designated Basins and Management Districts

- 1969 - Water Rights Determination and Administration Act
 - Established water courts
 - Incorporated tributary groundwater into prior appropriation system
 - Authorized augmentation plans
 - State Engineer Office becomes DWR

Upper Crow Creek

Camp Creek

Nebraska

Fort Collins

Lost Creek

Kiowa Bijou

Northern High Plains

Boulder

Denver

Kansas

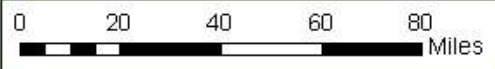
Colorado Springs

Upper Big Sandy

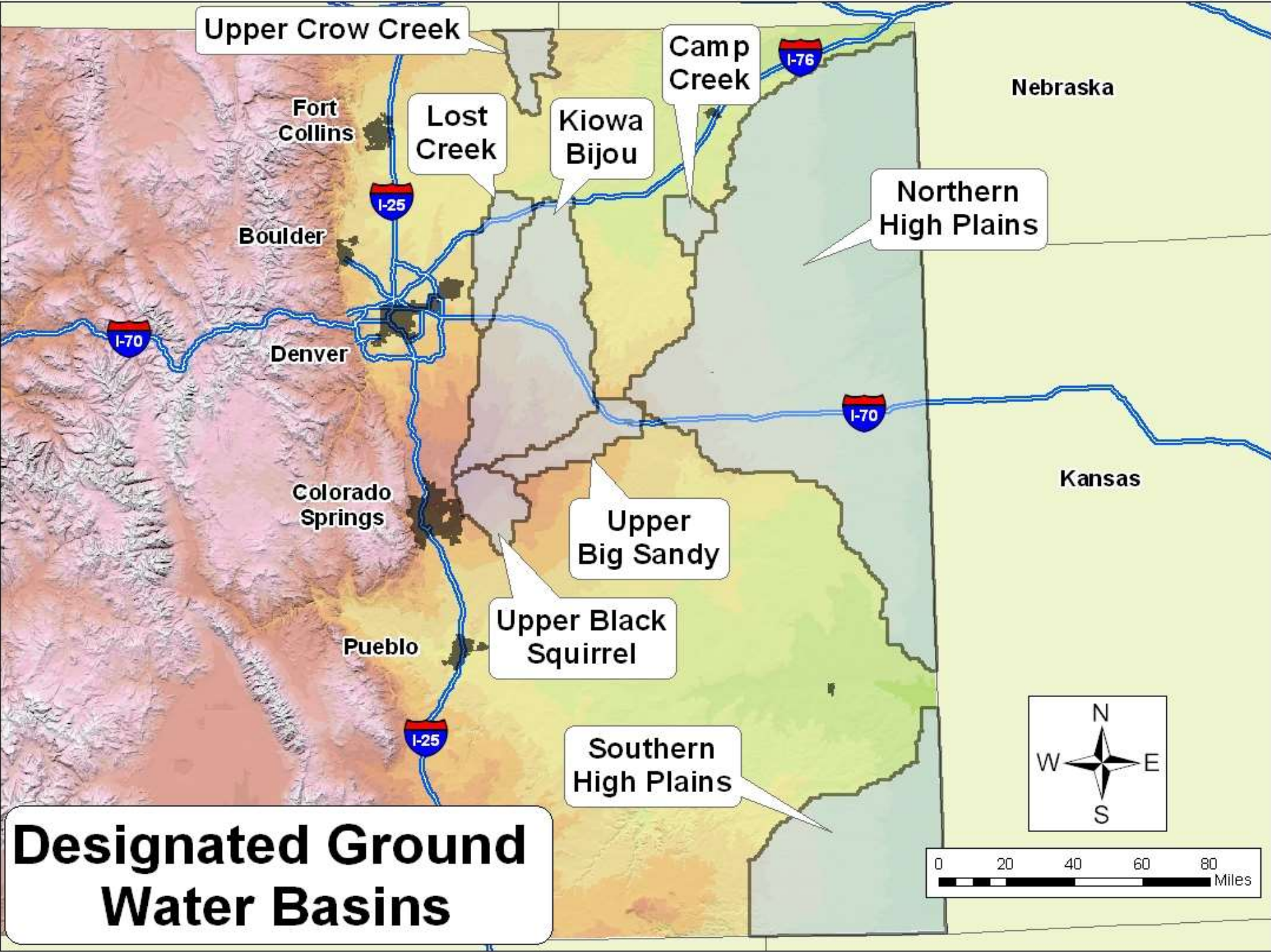
Upper Black Squirrel

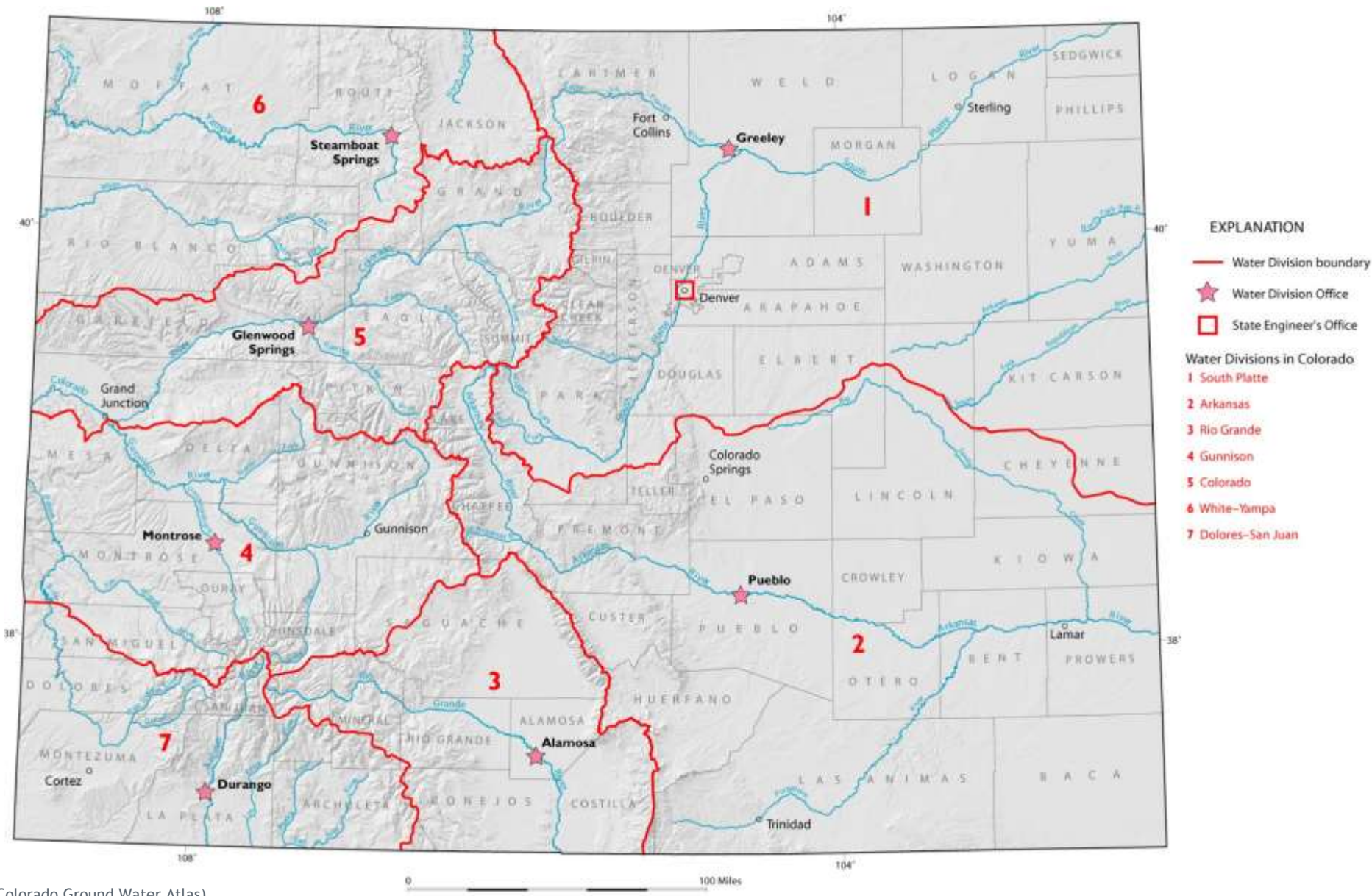
Pueblo

Southern High Plains



Designated Ground Water Basins





(Colorado Ground Water Atlas)

Groundwater Data and Information

- SB 87-200 Groundwater Management Cash Fund
 - Create and maintain groundwater information management system
 - HydroBase
 - Water Information Team
 - Conduct groundwater related activities deemed necessary by the State Engineer
 - Water-level monitoring programs
 - Hydrogeology Group

Northern High Plains Designated Basin (NHP)

Southern High Plains Designated Basin (SHP)

Upper Black Squirrel Designated Basin

Kiowa-Bijou Designated Basin

Camp Creek Designated Basin

Lost Creek Designated Basin

Upper Big Sandy Designated Basin

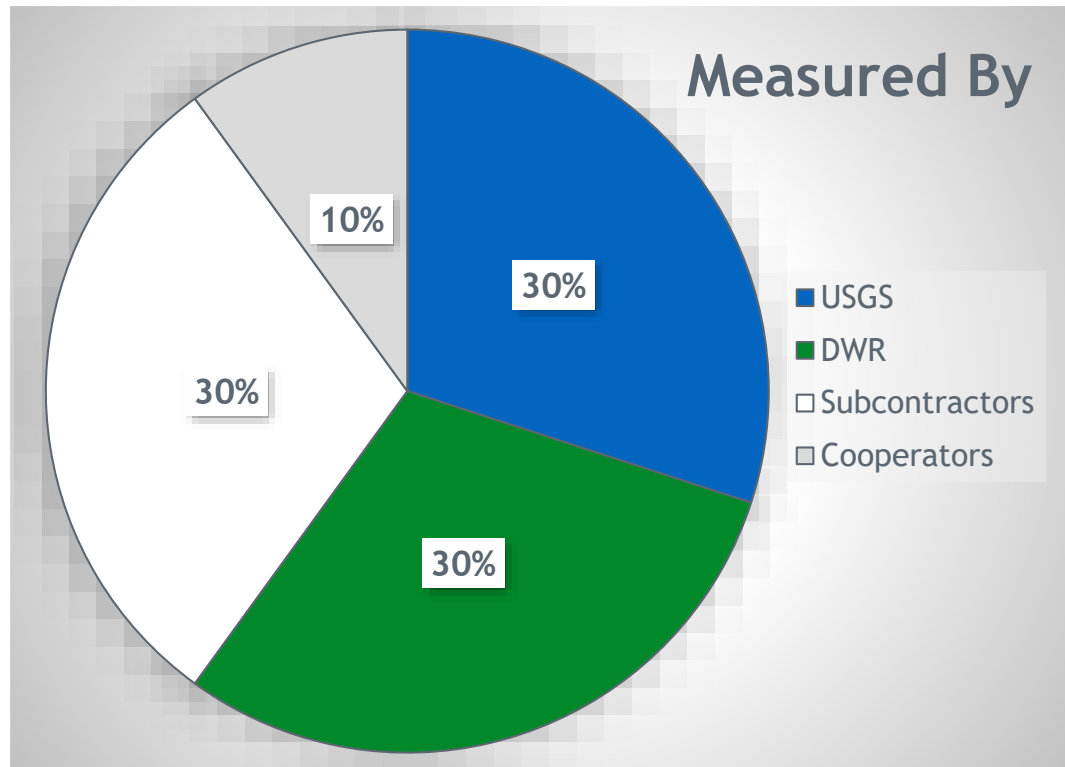
Denver Basin Bedrock Aquifers

Lower South Platte Alluvial Aquifer

West Slope Bedrock and Alluvial Aquifers

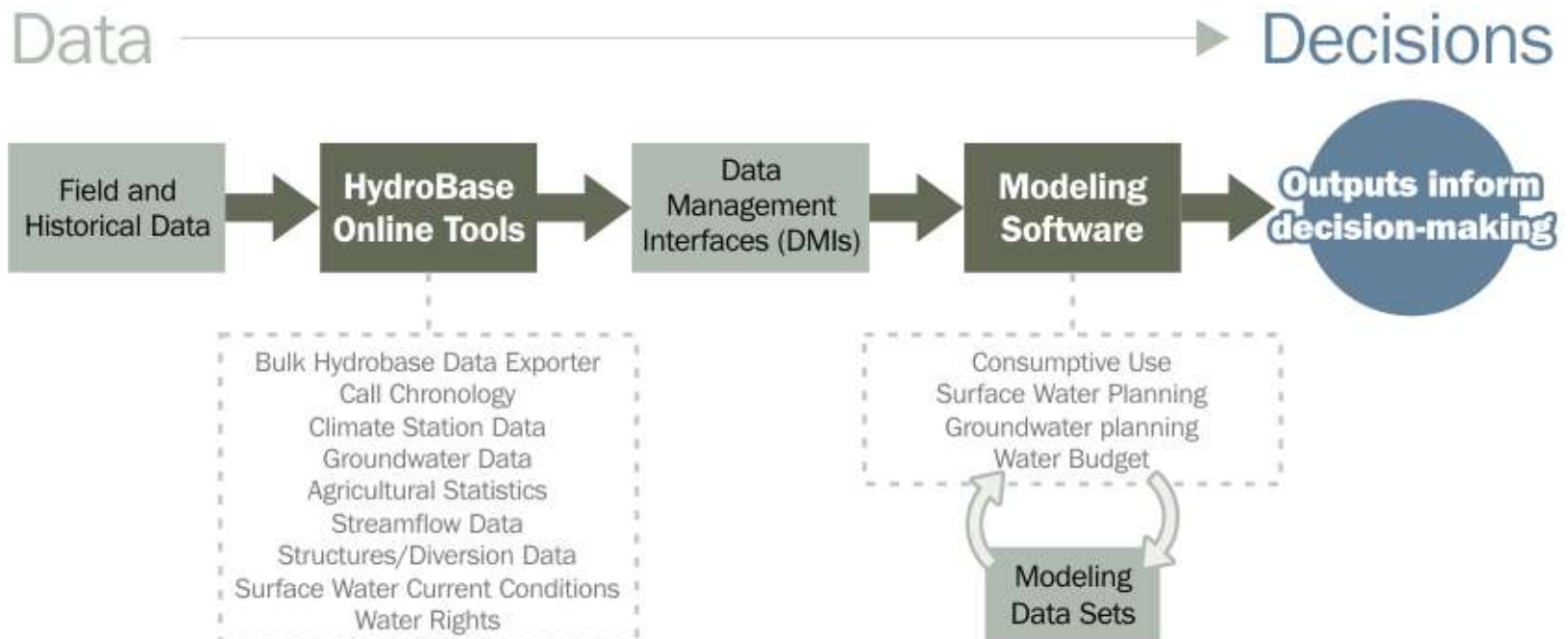
HydroBase - Water Level Database

- More than 22,500 wells
- Mostly USGS data populated through web services
- ~2,000 active water-level sites



Using Groundwater Data

- Publish annual water-level reports
- Assist with administration of water rights
- Used in groundwater models, water management systems
- Colorado Decision Support System (CDSS)



Using Groundwater Data

- Special Projects - High groundwater areas



Using Groundwater Data

3 illegal marijuana grows in El Paso County raided



Posted: Wed 5:01 PM, Oct 11, 2017 | Updated: Thu 6:46 AM, Oct 12, 2017



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Water theft for growing marijuana a concern for Saguache County officials

September 28, 2015 | Filed under: Headlines | Posted by: Dee Rudoff

Pueblo County making lots of money by embracing pot growing

by Lisa Cyriacks

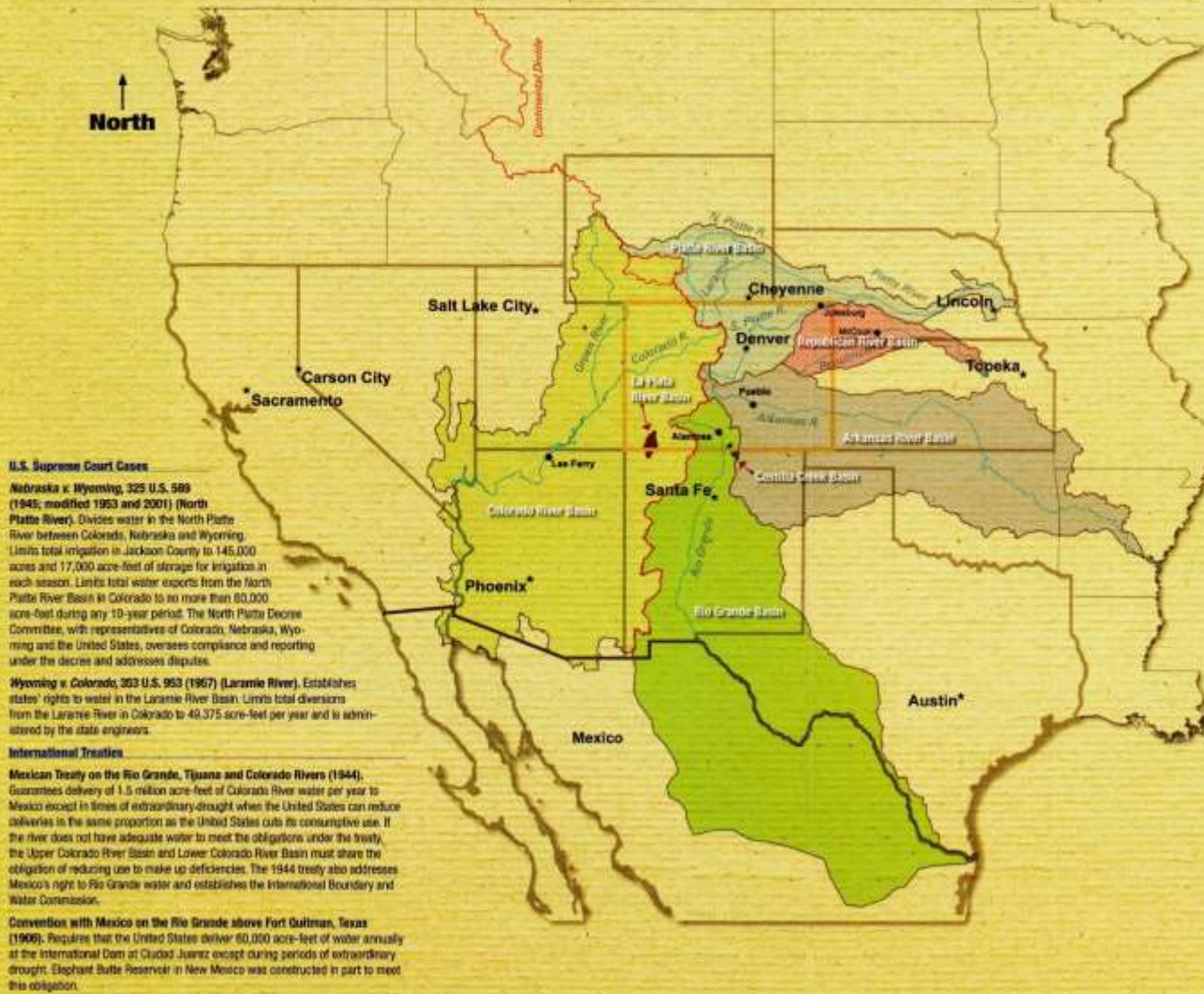
Saguache County Commissioners reported several dubious marijuana cultivation operations in the county—more than half in the Baca Grande subdivision—to the Colorado Division of Water Resources. These operations are possibly in violation of water permitting requirements and have not been approved by Saguache County as legal operations. It is not clear if these operations might be for personal use, medical marijuana grown by caregivers for patients, or commercial operations.

Caregivers don't have to register with the Marijuana Enforcement Division, but they must have proof that they are the designated provider for their patients, including a plant count for each patient. That information has to be provided to the Colorado Department of Public Health and Environment.

Saguache County is not alone in concern regarding water theft for marijuana cultivation operations. Costilla County, the only other county in the San Luis Valley where grow operations are permitted, shares these concerns.

Craig Cotten, Division 3 Water Engineer, recently addressed state legislators with enforcement concerns. Cotten questioned how his water commissioners, who are not armed and are not law-enforcement officers, should handle potentially dangerous growers.

The Headwaters State



U.S. Supreme Court Cases

Nebraska v. Wyoming, 325 U.S. 589 (1945; modified 1953 and 2001) (North Platte River). Divides water in the North Platte River between Colorado, Nebraska and Wyoming. Limits total irrigation in Jackson County to 145,000 acres and 17,000 acre-feet of storage for irrigation in each season. Limits total water exports from the North Platte River Basin in Colorado to no more than 80,000 acre-feet during any 10-year period. The North Platte Decree Committee, with representatives of Colorado, Nebraska, Wyoming and the United States, oversees compliance and reporting under the decree and addresses disputes.

Wyoming v. Colorado, 303 U.S. 953 (1967) (Laramie River). Establishes states' rights to water in the Laramie River Basin. Limits total diversions from the Laramie River in Colorado to 49,375 acre-feet per year and is administered by the state engineers.

International Treaties

Mexican Treaty on the Rio Grande, Tijuana and Colorado Rivers (1944). Guarantees delivery of 1.5 million acre-feet of Colorado River water per year to Mexico except in times of extraordinary drought when the United States can reduce deliveries in the same proportion as the United States cuts its consumptive use. If the river does not have adequate water to meet the obligations under the treaty, the Upper Colorado River Basin and Lower Colorado River Basin must share the obligation of reducing use to make up deficiencies. The 1944 treaty also addresses Mexico's right to Rio Grande water and establishes the International Boundary and Water Commission.

Convention with Mexico on the Rio Grande above Fort Quitman, Texas (1906). Requires that the United States deliver 60,000 acre-feet of water annually at the International Dam at Ciudad Juarez except during periods of extraordinary drought. Elephant Butte Reservoir in New Mexico was constructed in part to meet this obligation.

Interstate Compacts

South Platte River Compact (1923). Divides the waters of the South Platte River between Colorado and Nebraska, giving Colorado the right to fully use the water between Oct. 15 and April 1. During the irrigation season, when the flow is less than 120 cubic feet per second, Colorado must curtail diversions to any degree junior to June 14, 1897, from the Washington County line to the state line. The state engineers administer the compact.

Republican River Compact (1942). Divides the waters of the Republican River Basin between Colorado, Kansas and Nebraska. Colorado is granted the right to consume 54,100 acre-feet of water each year. The compact allocates 190,300 acre-feet of consumption each year to Kansas and 234,500 acre-feet each year to Nebraska. If the water supply of any source varies, the allocations also change. The Republican River Compact Administration, with representation from Colorado, Kansas and Nebraska, administers terms and oversees compliance.

Arkansas River Compact (1948). Divides the waters of the river between Colorado and Kansas primarily based on 1948 conditions. An interstate agency with representatives from Colorado, Kansas and the federal government administers provisions of the compact and oversees operations of John Martin Reservoir. Principles adopted by the interstate agency in 1980 provide for storage accounts in John Martin Reservoir for water users in both states.

Costilla Creek Compact (1944; revised 1963). Establishes uses, allocations and administration of the waters of Costilla Creek in Colorado and New Mexico. The 1963 amendment reallocated water between two of the ditches on the Costilla Creek system, and also made other minor adjustments to the original compact. The Costilla Creek Compact Commission, with representation from Colorado and New Mexico, administers terms and oversees compliance.

Rio Grande Compact (1938). Details obligations of Colorado and New Mexico to deliver water for downstream users, including Mexico; sets forth system of debits and credits and rules to account for fluctuations in streamflow. In Colorado, flows are delivered from the Rio Grande and Conejos River separately. Colorado usually must send between 35 percent and 75 percent of the rivers' water to the state line, depending on the year's flow. The Rio Grande Compact Commission, with representation from Colorado, New Mexico, Texas and the federal government, administers terms and oversees compliance.

Colorado River Compact (1922). Apportion 7.5 million acre-feet of consumptive use per year to the Upper Basin and up to 8.5 million acre-feet of consumptive use per year to the Lower Basin. The upper states may not consume water such that the flow of the Colorado River at Lee Ferry, Arizona, is depleted below an aggregate of 75 million acre-feet for any period of 10 consecutive years. The Department of the Interior, the Upper Colorado River Commission, and representatives designated by each Colorado River Basin state's governor work to monitor and administer compact compliance.

Upper Colorado River Compact (1948). Apportions a percentage of consumptive use from available river water to each Upper Basin state as follows: Arizona, 55,000 acre-feet each year; Colorado, 51.75 percent; Utah, 23 percent; Wyoming, 14 percent; and New Mexico, 11.25 percent. The Upper Colorado River Commission, with representation from Colorado, Wyoming, New Mexico, Utah and the federal government, administers the compact, and the state engineers from each upper division state administer water within their respective boundaries to achieve compact compliance.

La Plata River Compact (1922). Grants Colorado and New Mexico unrestricted use of the river between Dec. 1 and Feb. 15. At other times, each state can use the flow of the river if the flow at the state line is in excess of 100 cubic feet per second. When the flow is less, Colorado must deliver half of the preceding day's mean flow at Hesperus, Colo., but not more than 100 cubic feet per second. The state engineers administer the compact.

Arkansas-La Plata Project Compact (1968). Created because it addresses a water project rather than dividing river waters, the compact gives New Mexico and Colorado equal priority in rights to store and divert project water. The states' flows project has been repeatedly scaled back. The last remaining reservoir, Ridge Basin and Lake Nighthorn, first filled in August 2011.

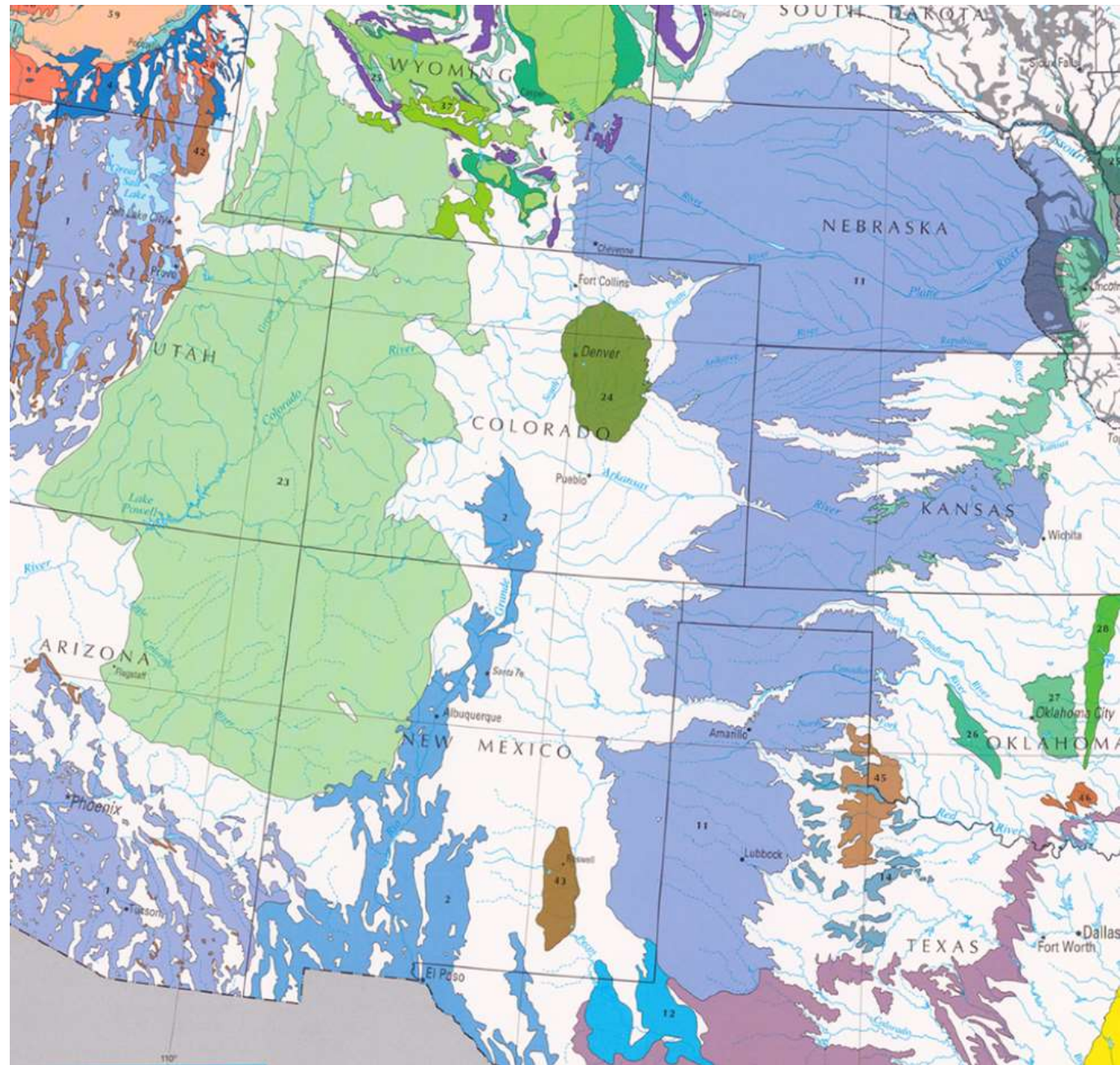
Principal Aquifers

2 - Rio Grande aquifer system

11 - High Plains aquifer

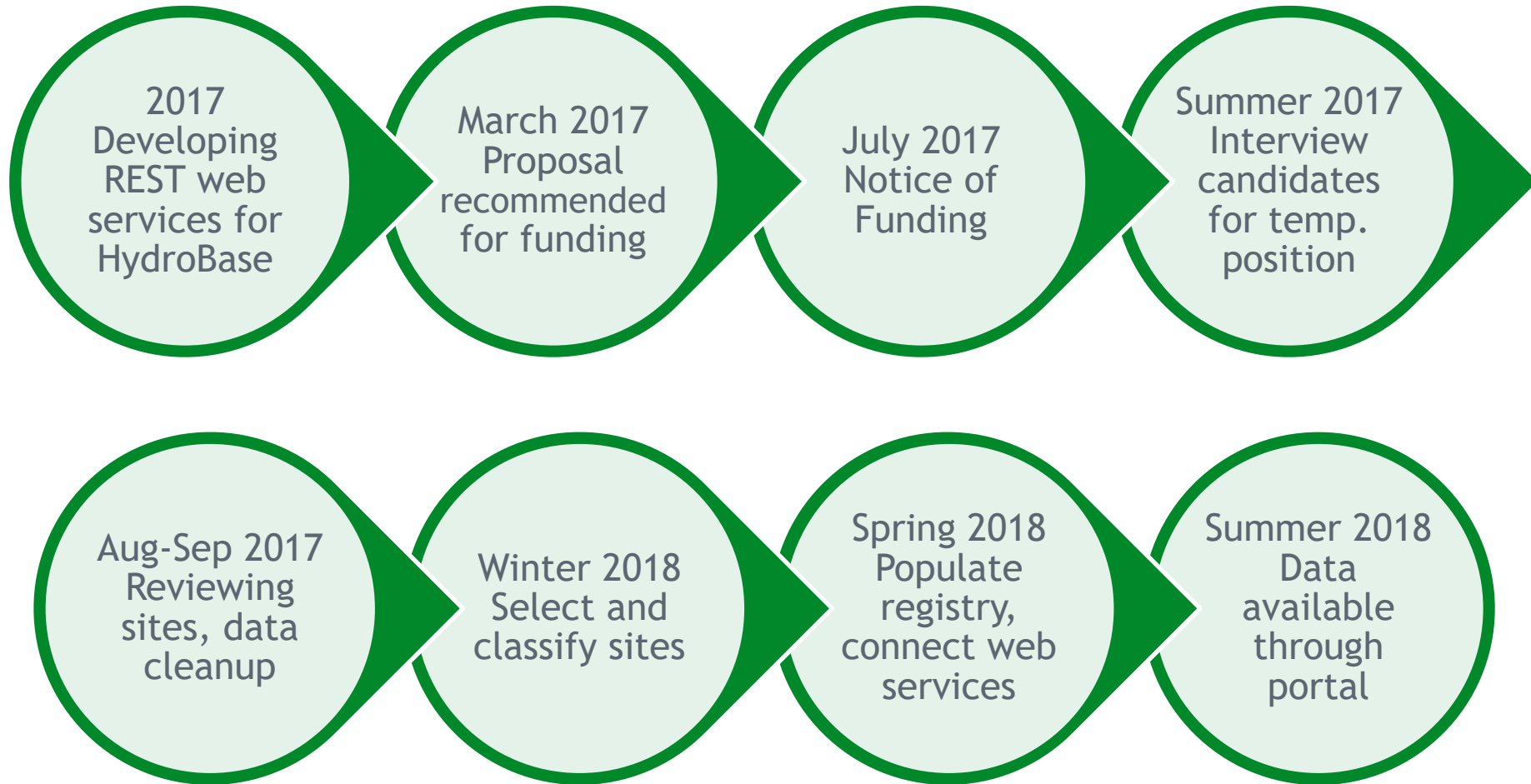
23 - Colorado Plateaus aquifers

24 - Denver Basin aquifer system

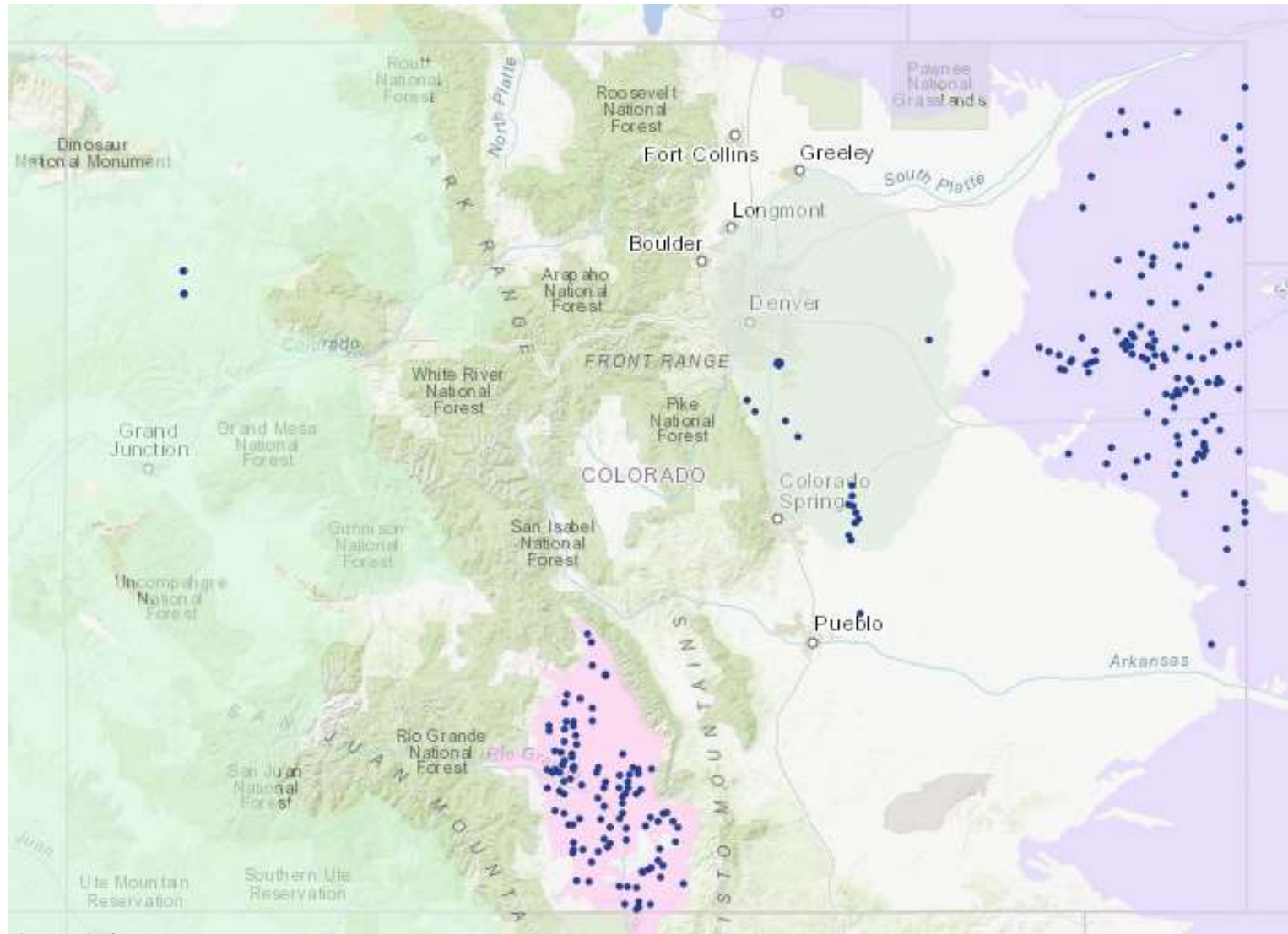


(nationalatlas.gov)

Data Provider Timeline

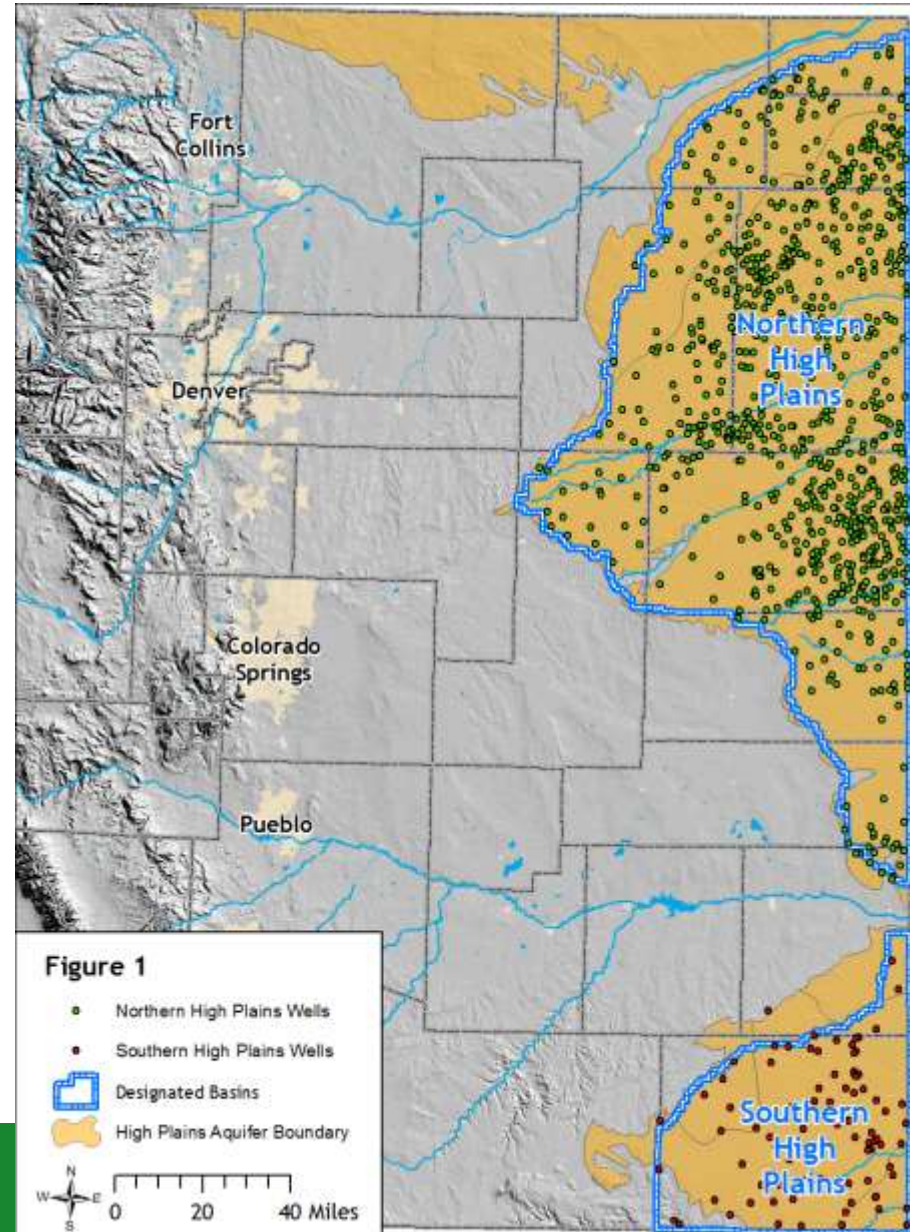
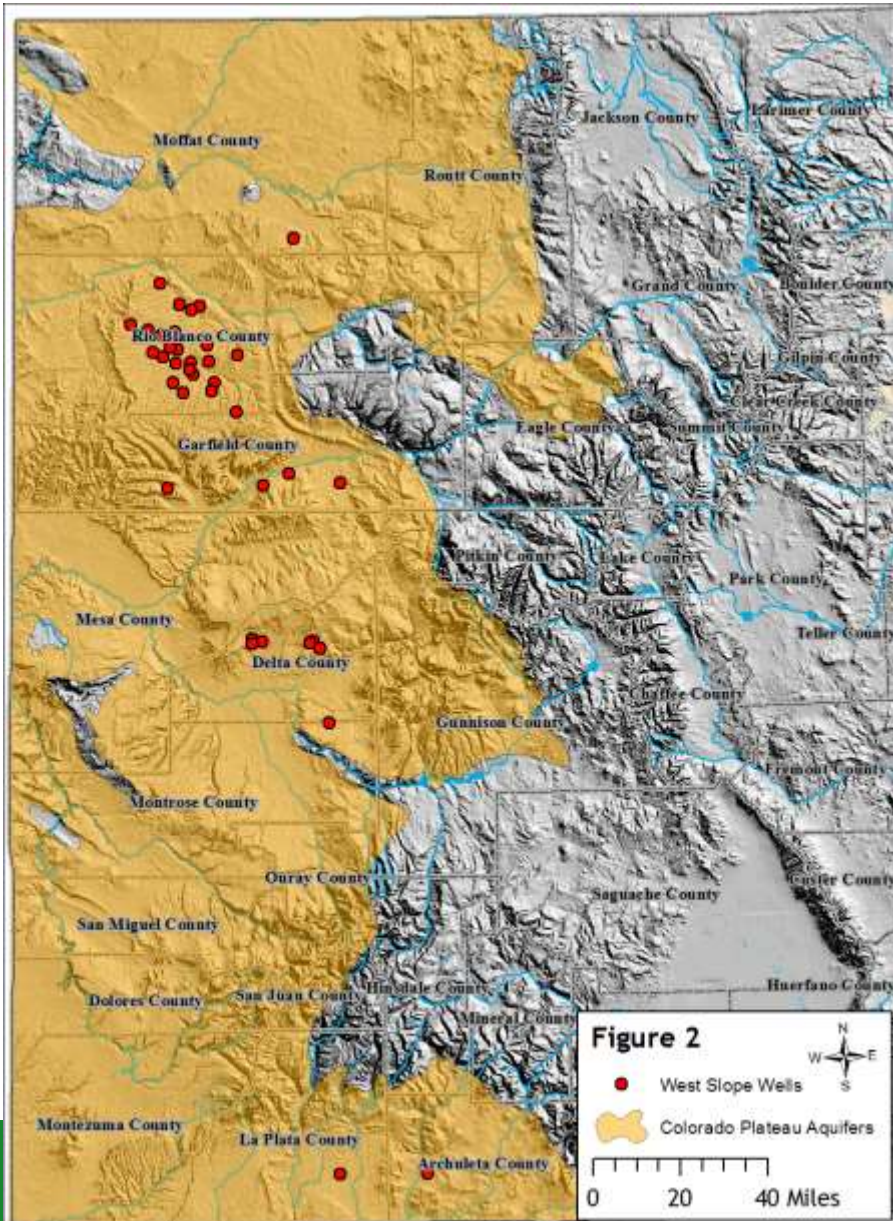


Site Selection and Classification



(<https://cida.usgs.gov/ngwmn/index.jsp>)

Site Selection and Classification



Site Selection and Classification

- Develop rubric for evaluating wells based on WL Selection Criteria
- Evaluate/select wells based on rubric
- Assign subnetwork and monitoring category

	1930s					1940s					1950s					1960s					1970s					1980s					1990s					2000s					2010s																																																	
LSP#	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016			
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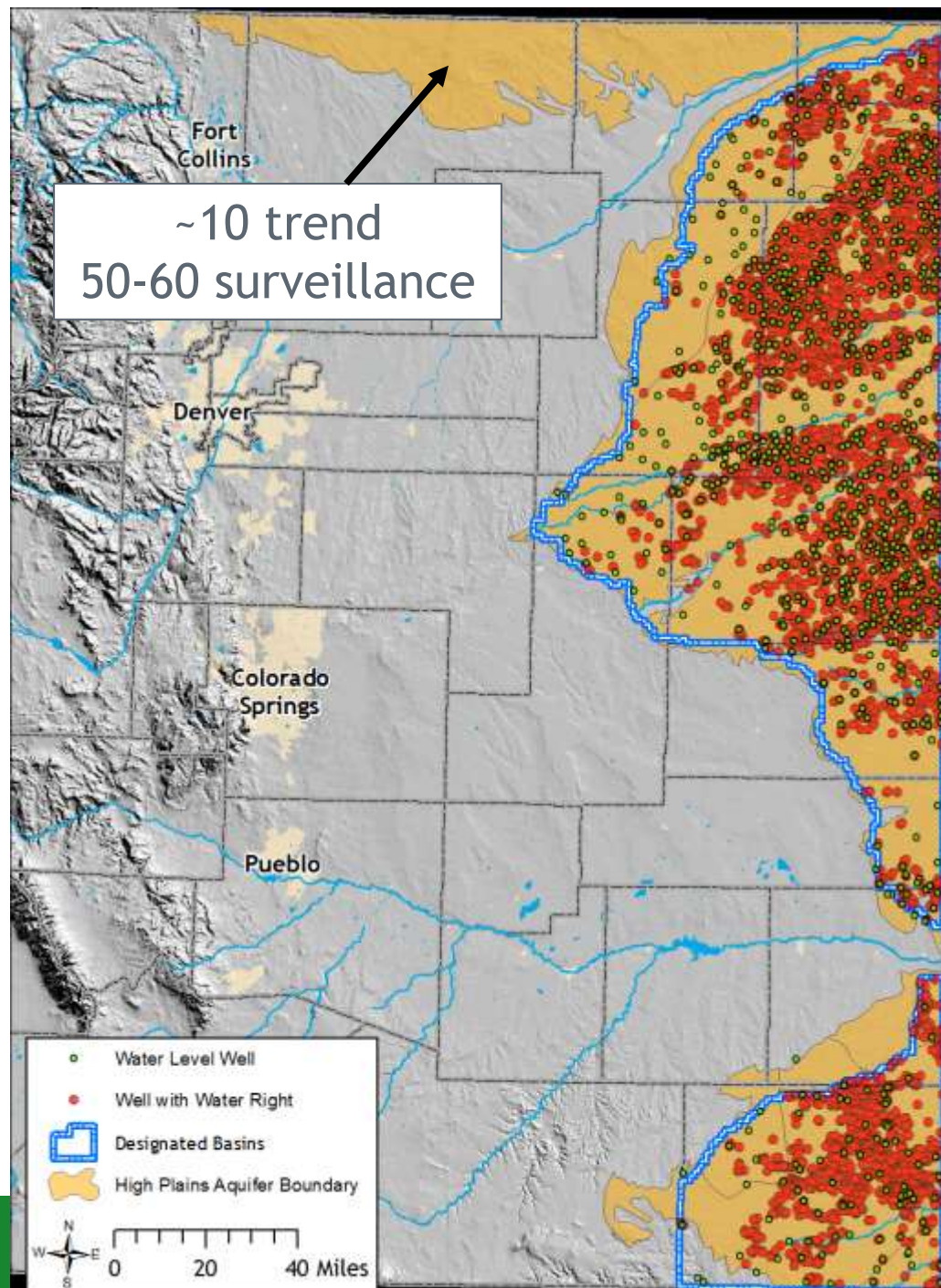
Subnetwork

Documented and Suspected Change

800 Active Wells

60-75 Trend Wells

300-400 Surveillance Wells



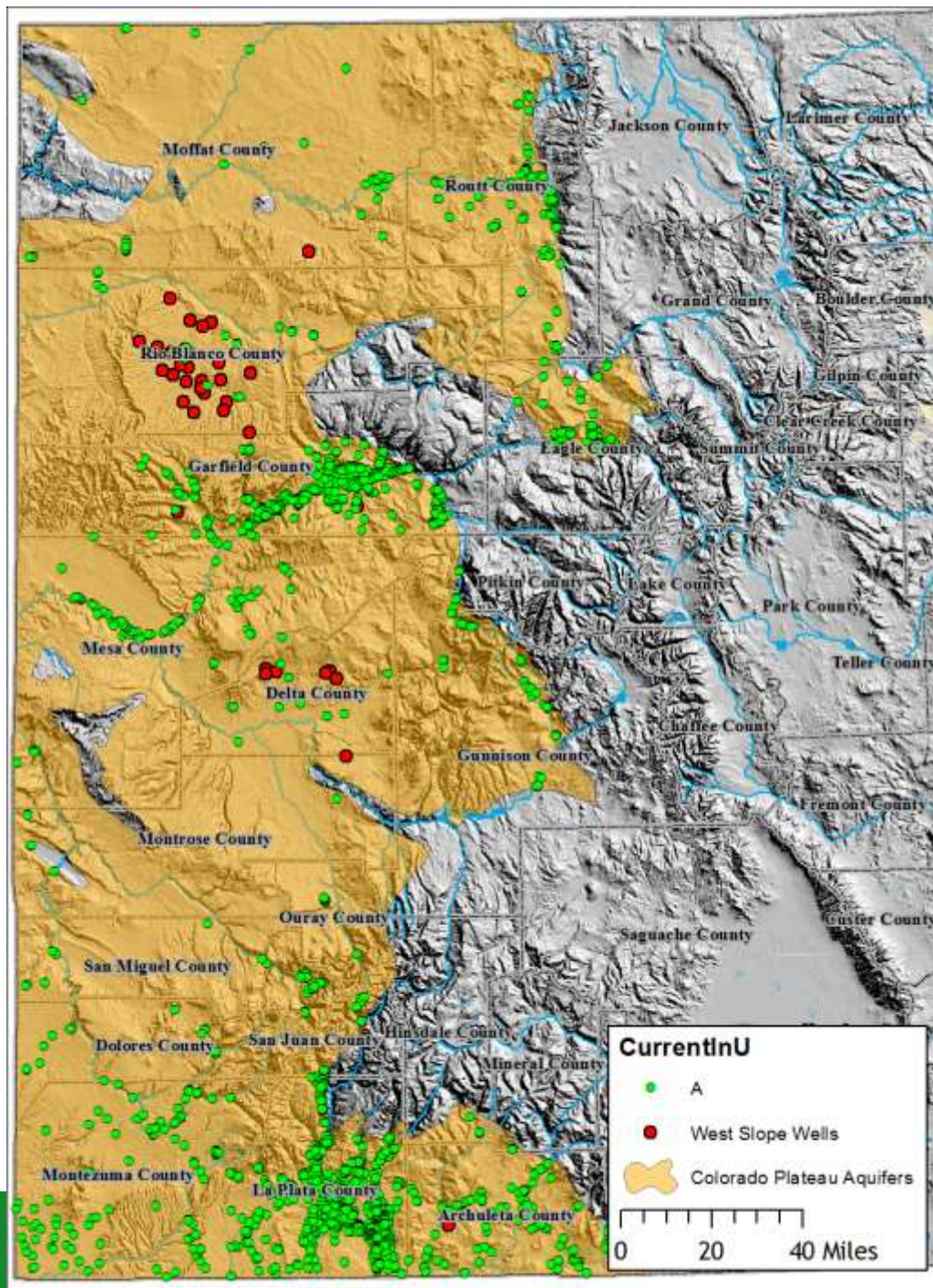
Subnetwork

Background Conditions

50 Active Wells

No Trend Wells
(at this time)

All Surveillance
Wells



Data Collection Methods and Protocols



> Ground Water > Ground Water Levels > Cooperator Program

- Designated Basins (CGWC)
- Ground Water Administration
- Ground Water Levels
 - Cooperator Program**
- Well Contractor Licensing (BOE)
- Well Permitting

Cooperator Program

Cooperator Groundwater Level Measurement Network

One of the components of [House Bill 15-1166](#) directed the State Engineer, in consultation with the Colorado Water Conservation Board (CWCB), to develop and publish protocols for groundwater level data measurement, collection, and entry. This webpage provides a link to those protocols (draft), as well as links to documents outlining the information necessary to setup a third-party account profile and documentation required for each well included in the monitoring program.

To participate in the Cooperator Program:

1. Download and complete the following forms:

[Primary Contact Customer Account Set-Up Form](#)

[Well Inventory Set-Up Spreadsheet \(Excel\)](#)



2. Submit both of the above forms by attaching them to the [AskDWR Request page](#).
3. You will be contacted once your account has been setup.

Submitting Water Level Measurements

1. Guidelines for taking Water Level Measurements: See [Groundwater Level Monitoring Protocols](#)
2. Groundwater Level Measurements can be submitted using the [DWR Online Submittal System](#). (Help: [User Guide](#))

If you experience a problem submitting your Groundwater Level Measurements in the DWR Online Submittal System, please contact us using this [AskDWR Request Page](#).

Quick Links

-  [Ground Water Levels Data Search \(CDSS\)](#)
-  [Ground Water Level Reports](#)

HydroBase

- Several Microsoft SQL Server databases
- Running on Microsoft Windows database servers
- WIT and Governor's Office of Information Technology



COLORADO'S
Decision Support Systems
CWCB / DWR

Search Fields Hide

Geographic Location: Water Division
All Divisions

Publication: All

Aquifer: All

Having water level measurement dates (optional)
From: To:

Additional Filter Options: Well Name
Starts With: nhp

Well Name	Permit No	Well Depth	Measurement Date	Water Level Depth	Water Level Elevation	Measurement By	POR Start	POR End	POR Count	Publication Name	Aquifer(s)	Elevation
View NHP-AR-001 RUFF...	11755-PP-R	83	2/1/2017	9.00	3,363.00	DWR	1/24/2011	2/1/2017	7	NORTHERN HIG...	OGALLALA	3,372.00
View NHP-AR-002 EIBE...	10931-	25	2/1/2017	21.70	3,738.84	DWR	6/21/1957	2/1/2017	40	NORTHERN HIG...	OGALLALA	3,760.54
View NHP-AR-003 WING...	280825-	80	2/1/2017	7.80	3,417.20	DWR	1/26/2010	2/1/2017	8	NORTHERN HIG...	OGALLALA	3,425.00
View NHP-AR-004 SOWM...	4594-R	84	2/1/2017	12.00	3,462.40	DWR	1/21/2010	2/1/2017	8	NORTHERN HIG...	OGALLALA	3,475.00
View NHP-AR-005 BUSJ...	12697-RFP	236	2/1/2017	198.10	3,578.97	DWR	9/12/1957	2/1/2017	47	NORTHERN HIG...	OGALLALA	3,777.07
View NHP-AR-006 WHD...	3057-PP	112	2/1/2017	14.60	3,645.96	DWR	4/24/1961	2/1/2017	32	NORTHERN HIG...	OGALLALA	3,660.56
View NHP-AR-007 MANS...	19763-F	220	2/1/2017	193.20	3,610.38	DWR	7/15/1956	2/1/2017	51	NORTHERN HIG...	OGALLALA	3,803.58
View NHP-AR-008 SOEH...	7197-R	293	2/1/2017	233.40	3,635.00	DWR	6/7/1955	2/1/2017	32	NORTHERN HIG...	OGALLALA	3,668.40
View NHP-AR-009 ZION...		26	2/1/2017	8.90	3,731.85	DWR	8/1/1956	2/1/2017	52	NORTHERN HIG...	OGALLALA	3,740.75
View NHP-AR-010 MCD...		90	2/1/2017	46.80	3,961.98	DWR	9/16/1977	2/1/2017	40	NORTHERN HIG...	OGALLALA	4,010.78
View NHP-AR-011 U.S. ...		66	2/1/2017	49.27	4,062.57	DWR	9/9/1977	2/1/2017	40	NORTHERN HIG...	OGALLALA	4,111.84
View NHP-AR-012 U.S. ...	20202-A	100	2/1/2017	37.70	4,131.16	DWR	9/6/1977	2/1/2017	40	NORTHERN HIG...	OGALLALA	4,168.86
View NHP-AR-013 POE...	11528-RFP	90	2/1/2017	37.40	3,540.13	DWR	7/1/1957	2/1/2017	32	NORTHERN HIG...	OGALLALA	3,577.53
View NHP-AR-014 SOEH...	6371-F	305	2/1/2017	261.00	3,629.61	DWR	11/23/1964	2/1/2017	32	NORTHERN HIG...	OGALLALA	3,890.61
View NHP-AR-015 BOW...	10546-F	330	2/12/2015	275.00	3,661.63	DWR	1/2/1967	2/12/2015	47	NORTHERN HIG...	OGALLALA	3,936.63

HydroBase Web Applications



Groundwater - Water Levels

Export Help

Well Name: NHP-CY-054 SEEDORF, C.D.

Permit Number: 14164-FP

Location Number: SC00204811ACA

WDID: 6507379

USGS Site ID: 395355102425000

Data Source: DWR

Applicant/Contact: SEEDORF C D

Measurements

Site Description

Filters Hide

All Measurements Published Only

Full Record 09/01/1969 to 01/18/2017

From 09/01/1969 To 01/18/2017

Submit

Display Option

Title NHP-CY-054 SEEDORF, C.D.

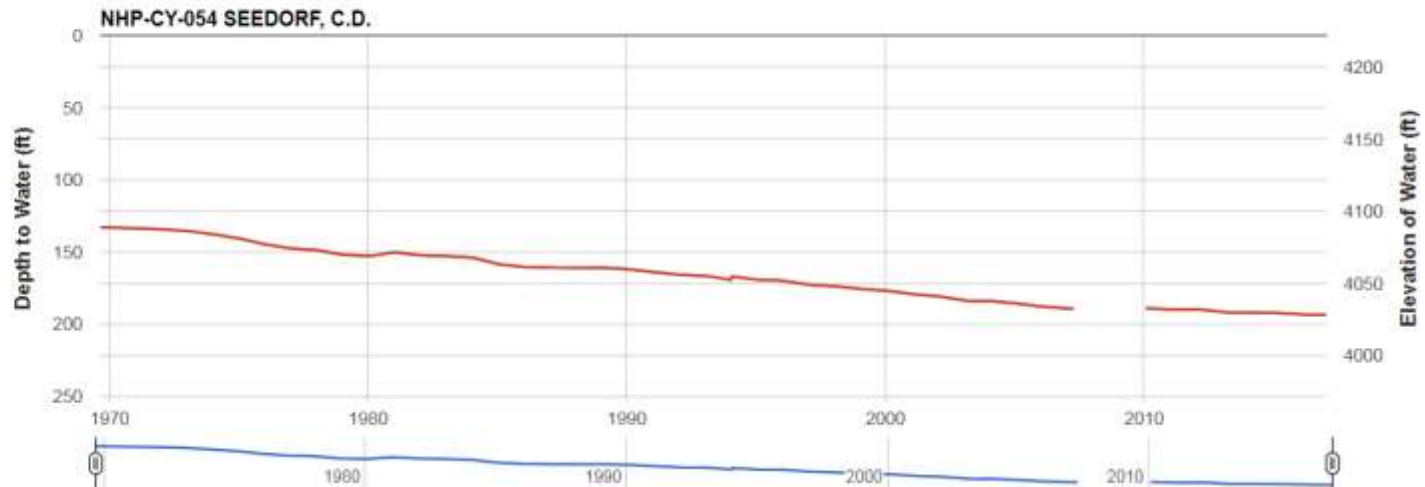
Y Axis Max 254

Y Axis Min 0

Refresh

Graph

Table



HydroBase Web Services



COLORADO'S
Decision Support Systems
CWCB / DWR

Groundwater - Water Levels

Export Help

Search Fields Hide

Geographic Location Water Division

All Divisions

Publication All

Aquifer All

Having water level measurement dates (optional)

From To

Additional Filter Options Well Name

Starts With nhp

Search

Additional Resources

[Colorado Information Marketplace](#)

[DWR Web Services](#)

Table Map

	Well Name	Permit No	Well Depth	Measurement Date	Water Level Depth	Water Level Elevation	Measurement By	POR Start	POR End	POR Count	Publication Name	Aquifer(s)	Elevation
View	NHP-AR-001 RUFF...	11755-PP-R	83	2/1/2017	9.00	3,363.00	DWR	1/24/2011	2/1/2017	7	NORTHERN HIG...	OGALLALA	3,372.00
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View	NHP-AR-009 ZION...		26	2/1/2017	8.90	3,731.85	DWR	8/1/1956	2/1/2017	52	NORTHERN HIG...	OGALLALA	3,740.75
View	NHP-AR-010 MCD...		90	2/1/2017	48.80	3,901.98	DWR	9/16/1977	2/1/2017	40	NORTHERN HIG...	OGALLALA	4,010.78
View	NHP-AR-011 U.S. ...		66	2/1/2017	49.27	4,063.57	DWR	9/9/1977	2/1/2017	40	NORTHERN HIG...	OGALLALA	4,111.84
View	NHP-AR-012 U.S. ...	202922-A	100	2/1/2017	37.70	4,131.16	DWR	9/6/1977	2/1/2017	40	NORTHERN HIG...	OGALLALA	4,168.86
View	NHP-AR-013 POE...	11528-RFP	90	2/1/2017	37.40	3,540.13	DWR	7/1/1957	2/1/2017	32	NORTHERN HIG...	OGALLALA	3,577.53
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1 - 50 of 718 items

Sample:

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    <modified>2017-12-04T20:54:44.2356167-07:00</modified>
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    <wellName>sample string 2</wellName>
  </GroundWaterMeasurement>
</ArrayOfGroundWaterMeasurement>
```


NGWMN Web Services

- Will return XML using WaterML2 and GWML2 using REST protocol
- Create database views and stored procedures with an MS Visual Studio interface
- Web services in a C# .NET environment
- Will set up separate service for USGS to allow infinite access compared to anonymous computers

Missing Data Elements

- Lithology

DRILLERS TEST LOG

CUSTOMERS NAME Dr. Earl Berens DATE July 14, 1985
 STREET ADDRESS 48525 Hogan Dr. TEST # 2 E. LOG yes
 CITY & STATE Burlington, CO 80807 DRILLER Livingston
 COUNTY Kit Carson QUARTER NE SECTION 9 TOWNSHIP 10 RANGE 46
 LOCATION 300 ft. north of well

WELL LOCATION

%	FOOTAGE		DESCRIPTION OF STRATA	Static Water Level
	From	Pay To		Proposed Well Depth
	0	2	Top soil	
	2	41	Brown sandy clay and fine sand streaks	
	41	61	Sand fine to medium, small gravel few clay and cemented streaks	
	61	80	Brown sandy clay, limerock cemented sand	
	80	107	Sand fine to medium, cemented and clay streaks	
	107	121	Sand fine to medium, small gravel cemented	
	121	127	Brown sandy clay limerock	
	127	141	Sand fine to medium, coarse	
	141	147	Cemented sand	
	147	151	Sandy clay and sand streaks	
	151	160	Sand fine to medium, and clay streaks	
	160	187	Sand fine to medium, small gravel and few cemented streaks and clay streaks	
	187	191	Cemented sand and clay streaks	
60	191	09	200	Sand fine to medium, coarse, small gravel cemented ledges
70	200	25	225	Sand fine to medium, coarse, small gravel few medium gravel loc
	225	232	Yellow soapstone	
				Total Depth 230'
				Set up North
				Pit on the East

Benefits So Far...

- Well site info clean-up
- Better understanding of web services and data sharing
- Interagency cooperation within Colorado
- Relationships with USGS and other states
- And most importantly...

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COLORADO
Division of Water Resources
Department of Natural Resources

Links

Colorado Division of Water Resources (DWR) Website

<http://water.state.co.us>

Colorado Decision Support Systems (CDSS) - aka HydroBase

<http://dnrweb.state.co.us/cdss/GroundWater/GroundWaterSearch>

Colorado Information Marketplace - Bulk Download

<https://data.colorado.gov/Water/DWR-Well-Water-Level/hfwh-wsgi>

CDSS Map Viewer - Map Based Download

<http://water.state.co.us/DataMaps/GISandMaps/MapView/MapViewer/Pages/FAQ.aspx>

Published Groundwater Level Reports - PDF Reports

<http://water.state.co.us/groundwater/Pages/HydroGeo.aspx>

Questions?



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