

What and Where Are Designated Groundwater Basins
and
What and Where Are the
Denver Basin Groundwater Aquifers

Presented by
Robert Longenbaugh
Consultant Water Engineer
4103 Stoney Creek Dr.
Fort Collins, CO 80525

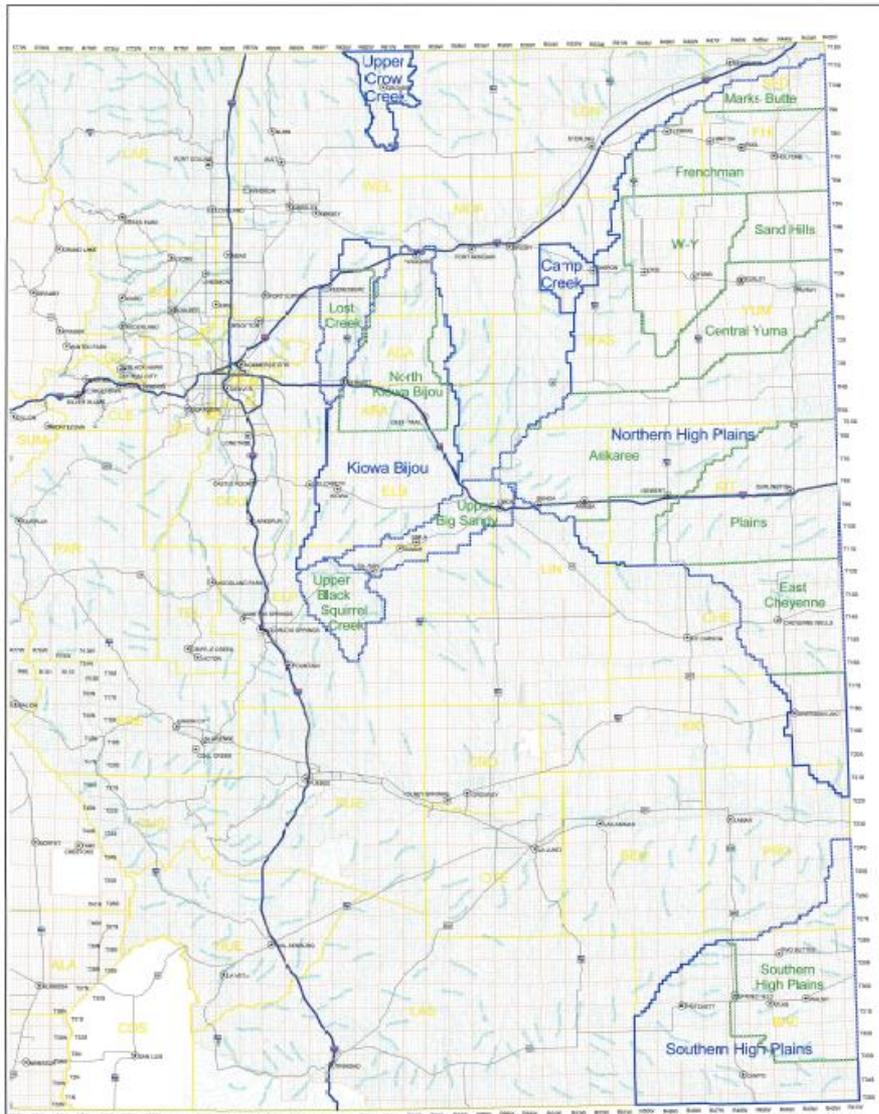
Presented to the Water Resources Review Committee,
Colorado Legislature

September 4, 2014

Designated Ground Water Basins

Created by the 1965 Ground Water Management Act:
37-90-101 through 37-90-135 C.R.S.

- Statute provides a definition for Designated Ground Water
- Statute creates a Ground Water Commission
- Commission shall determine and establish Designated Ground Water Basins
- Ground Water Management Districts provide for implementation for localized control
- Both the Commission and Management Districts required to work together to manage the Designated Ground Water and prevent injury to vested water rights.

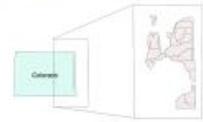


Designated Basin Code	Management District Code
100	100
101	101
102	102
103	103
104	104
105	105
106	106
107	107
108	108
109	109
110	110
111	111
112	112
113	113
114	114
115	115
116	116
117	117
118	118
119	119
120	120
121	121
122	122
123	123
124	124
125	125
126	126
127	127
128	128
129	129
130	130
131	131
132	132
133	133
134	134
135	135
136	136
137	137
138	138
139	139
140	140
141	141
142	142
143	143
144	144
145	145
146	146
147	147
148	148
149	149
150	150
151	151
152	152
153	153
154	154
155	155
156	156
157	157
158	158
159	159
160	160
161	161
162	162
163	163
164	164
165	165
166	166
167	167
168	168
169	169
170	170
171	171
172	172
173	173
174	174
175	175
176	176
177	177
178	178
179	179
180	180
181	181
182	182
183	183
184	184
185	185
186	186
187	187
188	188
189	189
190	190
191	191
192	192
193	193
194	194
195	195
196	196
197	197
198	198
199	199
200	200

DESIGNATED GROUND WATER BASINS AND GROUND WATER MANAGEMENT DISTRICTS

0 20 Miles

1:750000



Definition Designated Ground Water

Definition of Designated Basins 37-90-103(6) C.R.S.

“Designated ground water” means that ground water which in its natural course would not be available to and required for the fulfillment of decreed surface rights, or ground water in areas not adjacent to a continuously following natural stream wherein ground water withdrawals have constituted the principal water usage for at least fifteen years preceding the date of the first hearing on the proposed designation of the basin, and which in both cases is within the geographic boundaries of a designated ground water basin.

Determination of Designated Ground Water Basins

Findings Needed by the Commission:

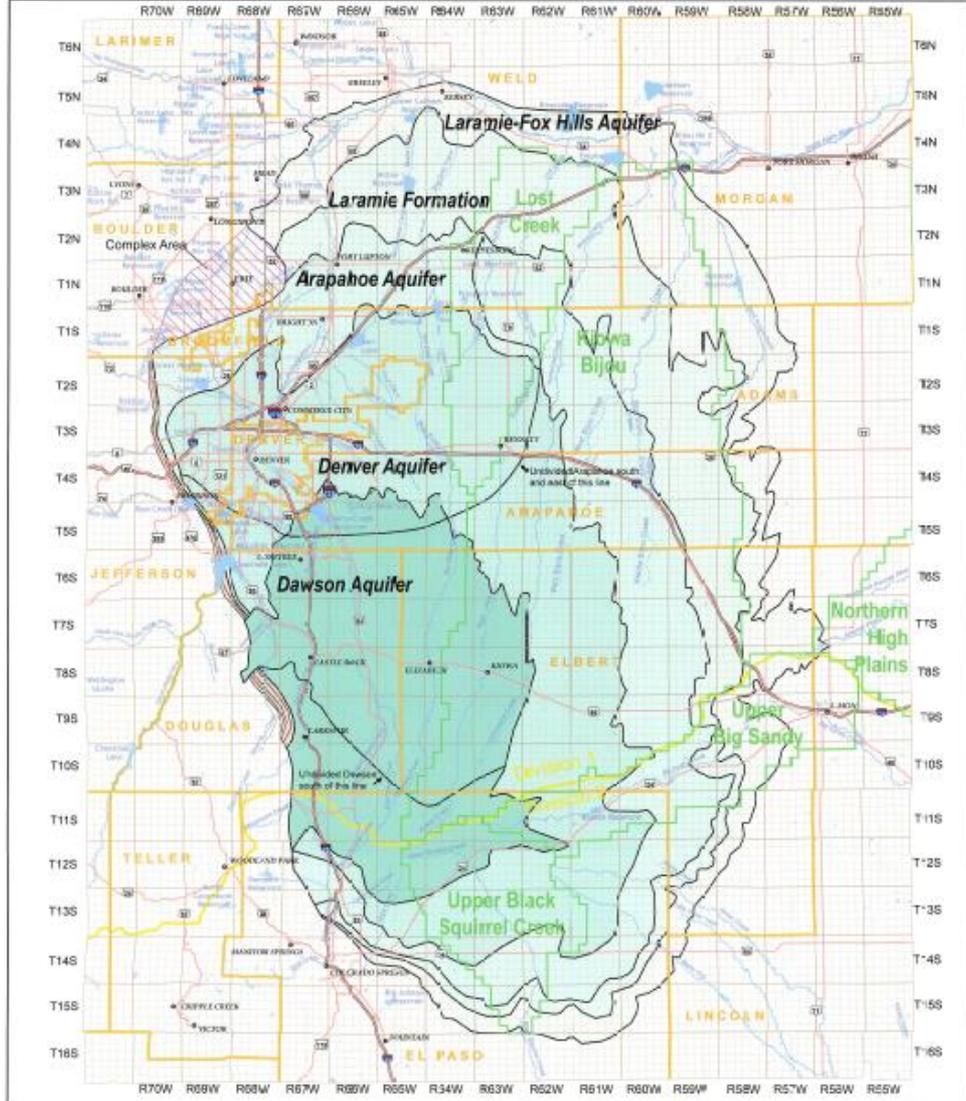
- Name of aquifer within proposed basin
- Boundaries of each aquifer
- Quantity of water stored in each aquifer
- Estimated annual rate of recharge
- Estimated use of ground water
- History for existing large capacity wells

Other Provisions of the Statues

- Commission develop management objectives
- Issue Well Permits: small and large capacity
- Water controlled by Commission not Water Courts
- Modified priority system
- Duties of State Engineer
- Both Commission and Management District can promulgate rules and regulations

Some current and Forthcoming issues:

- Management Districts implement water conservation or priority administration
- Administration becoming much more complex: Replacement plans, subdivision development, Water demand from Front Range municipalities
- Budget demands, staffing, technology issues



Source:
 State Water Aquifer Designated Basins and
 Boundaries, Colorado Division of Water Resources
 Counties, Colorado Department of Land and
 Air Quality, Colorado Department of Transportation
 Aerial Imagery, © 2000 Digital Line Data



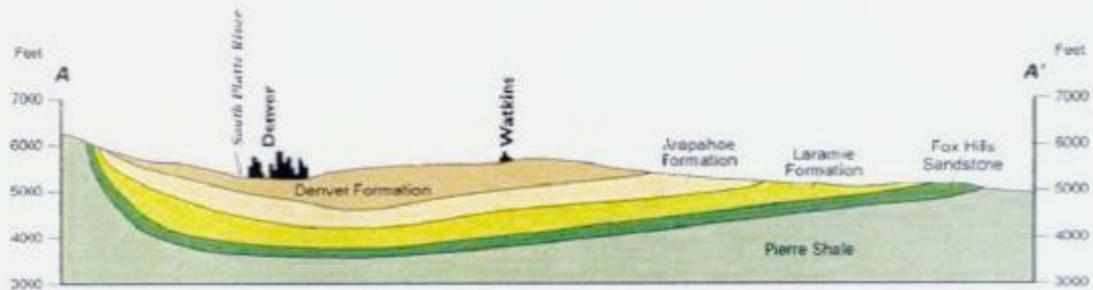
Division of Water Resources
 State of Colorado
DENVER BASIN AQUIFER

SCALE 1:275,000
 0 5 10 15 20 Miles

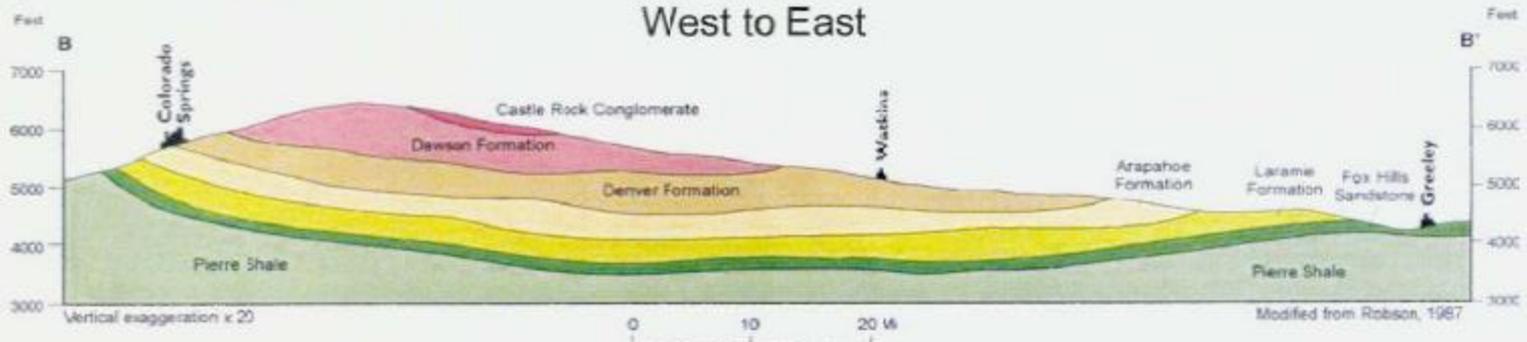
- Legend**
- District
 - Designated Basin
 - County
 - Township
 - Section
 - Laramie-Fox Hills Aquifer
 - Laramie Formation
 - Arapahoe Aquifer
 - Denver Aquifer
 - Dawson Aquifer
 - Park



Cross Section of the Denver Basin



West to East



South to North

Elevations are above sea level

Definition of Not Nontributary Ground Water

“Nontributary ground water” means that ground water, located outside the boundaries of any designated ground water basins in existence on January 1, 1985, the withdrawal of which will not, within one hundred years, deplete the flow of a natural stream, including a natural stream as defined in sections 37-82-101 (2) and 37-92-102 (1) (b), at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal. The determination of whether ground water is nontributary shall be based on aquifer conditions existing at the time of permit application.

Definition of Not Nontributary Ground Water

“Not nontributary ground Water” means ground water located within those portions of the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifer that are outside the boundaries of any designated ground water basin in existence on January 1, 1985, the withdrawal of which will, within one hundred years, deplete the flow of a natural stream, including a natural stream as defined in sections 37-82-101 (2) and 37-92-102 (1) (b), at an annual rate of greater than one-tenth of one percent of the annual rate of withdrawal.

Denver Basin Aquifer Development

- Pre 1957 - no permit required
- Period 1957 - 1965 all permits issued
- Post 1965 to December 1985
- Post December 1985 – Senate Bill 5 (1985)

Denver Basin Aquifer Rules and Regulations

- Maps of different formations
- Maps showing “Nontributary” line
- Annual volume limit on permit-based upon land ownership or right to use.
- Two percent relinquishment, Four percent augmentation, Actual full augmentation – one mile of stream contact.
- Determination of Water Right - Water Court

Hydrologic and Geologic Considerations

- Aquifers are both confined and unconfined
- Piezometric heads and water table elevations are declining
- We are mining the water from the aquifers – volume pumped exceeds natural recharge
- Well yields (gpm) are declining requiring more wells to pump the same volume
- Need renewable resource to supplement nontributary pumping.
- Artificial Recharge can have benefits but must manage withdrawals and recharge.
- Water quality and subsidence issues.

Administration of the Denver Basin Aquifers

Kevin Rein, Deputy State Engineer
Division of Water Resources

September 4, 2014

```
graph LR; A((SB73-213 Statutes)) --> B([Denver Basin Administration]);
```

SB73-213
Statutes

Denver Basin
Administration

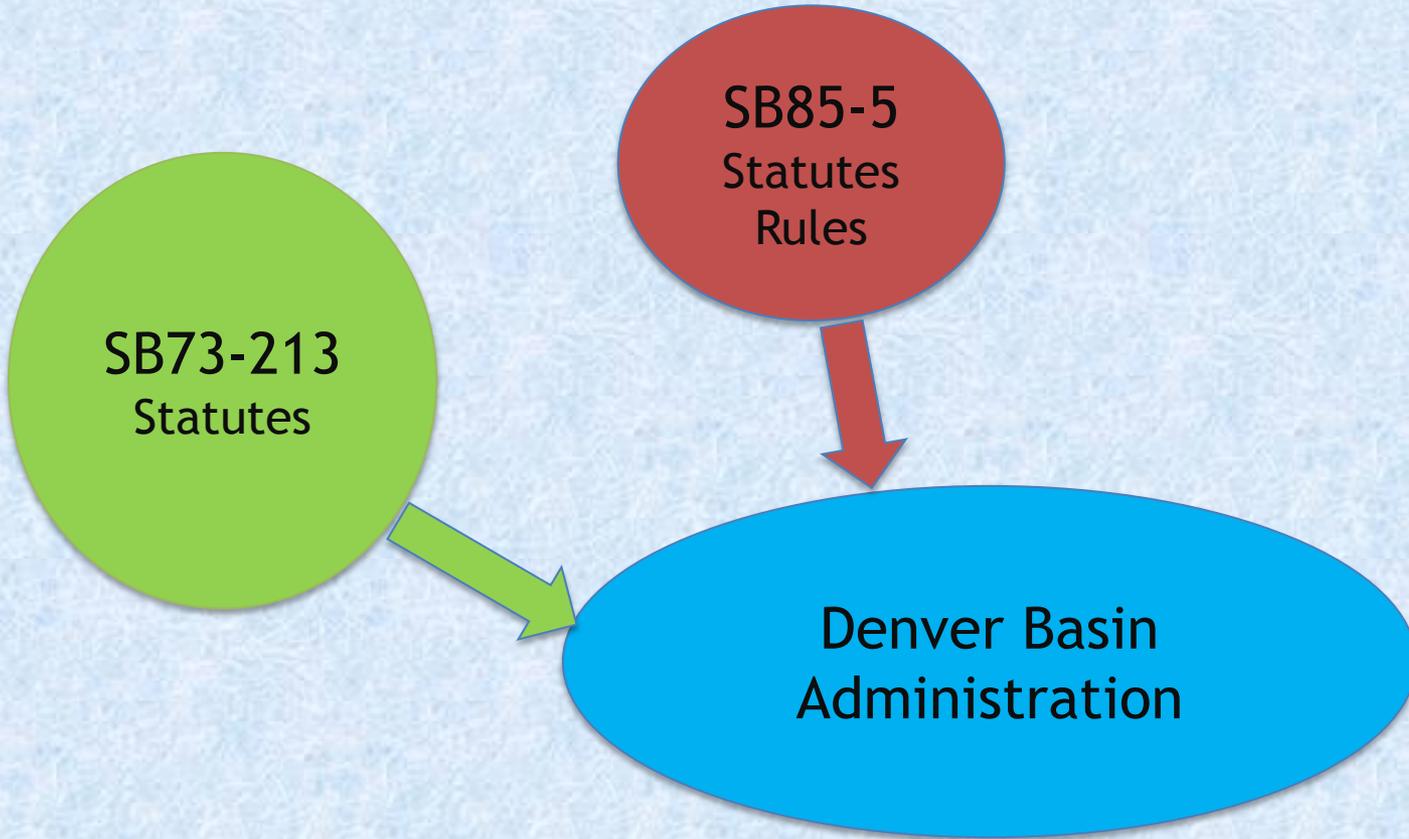
Senate Bill 213 (1973)

- Land area allocation
- One percent per year (100-year Aquifer Life)

SB85-5
Statutes
Rules

SB73-213
Statutes

Denver Basin
Administration



Senate Bill 5 (1985)

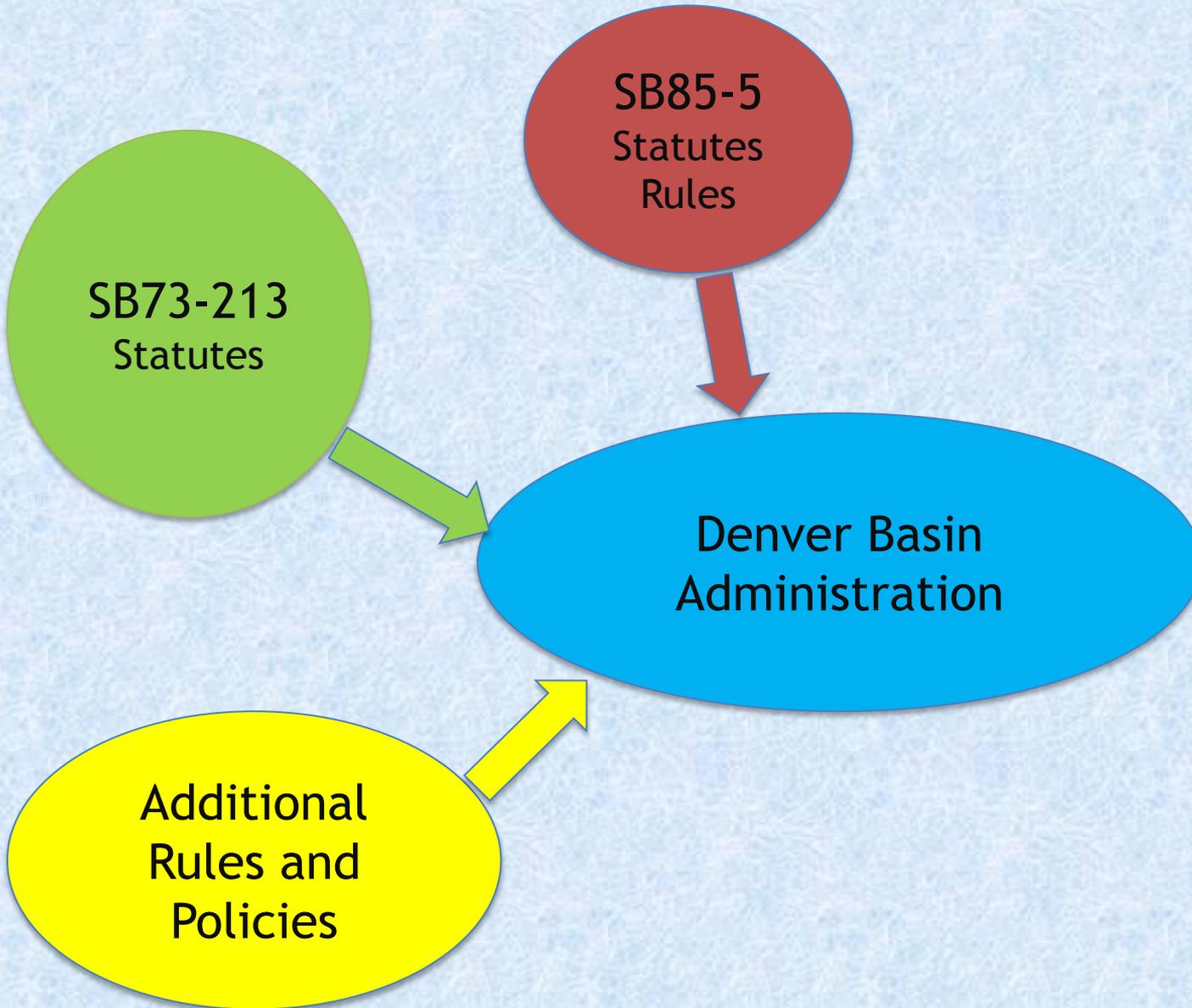
- Guidance on land area allocation
- Definition of “nontributary”
- Guidance on adjudication (water court)
- Rulemaking authority
 - Presumptive aquifer characteristics
 - Well permitting

SB85-5
Statutes
Rules

SB73-213
Statutes

Denver Basin
Administration

Additional
Rules and
Policies



Additional Rules and Policies

- Rules
 - Use of artificial recharge (1995)
- Policies
 - Multiple policies that address well permitting

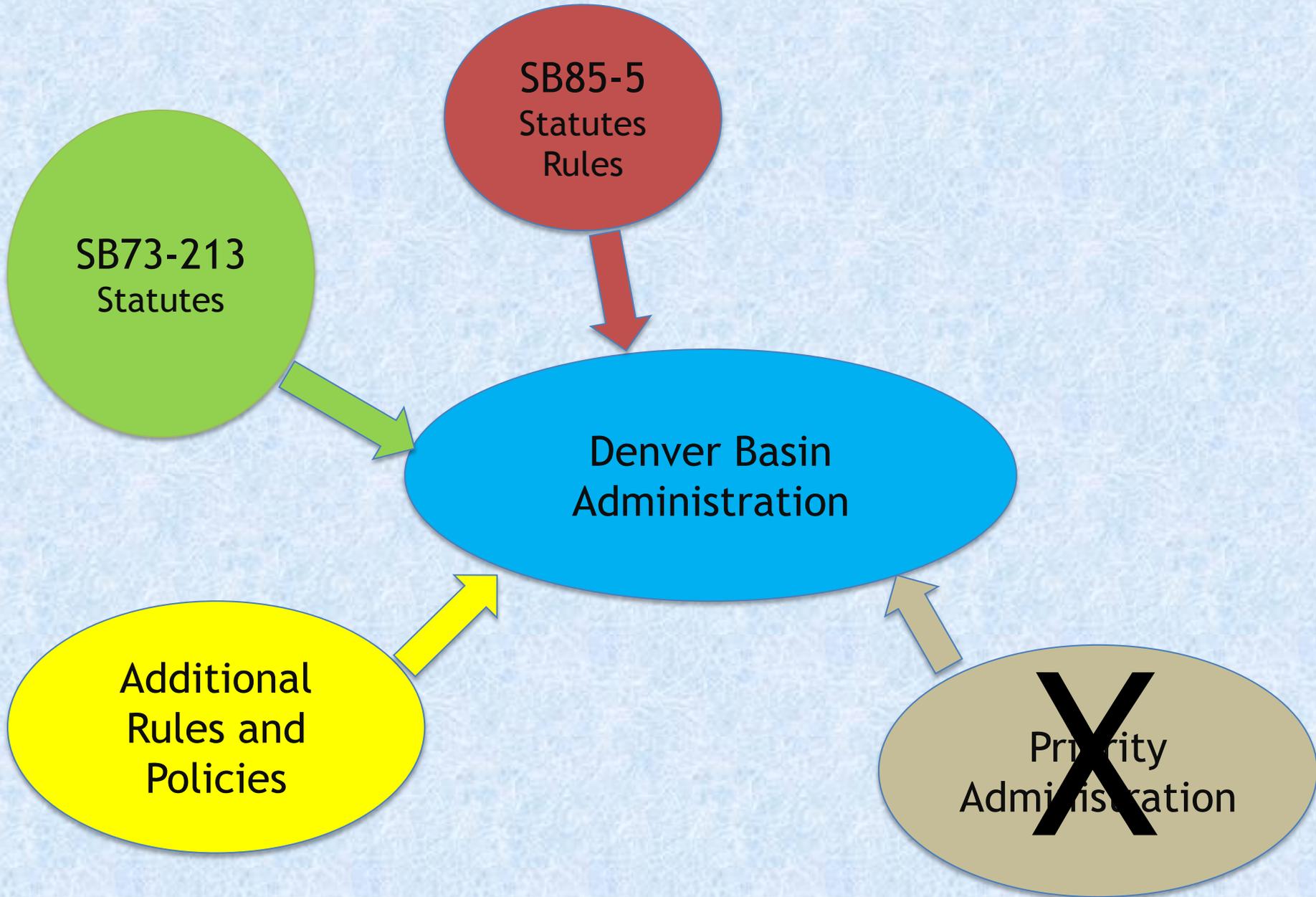
SB85-5
Statutes
Rules

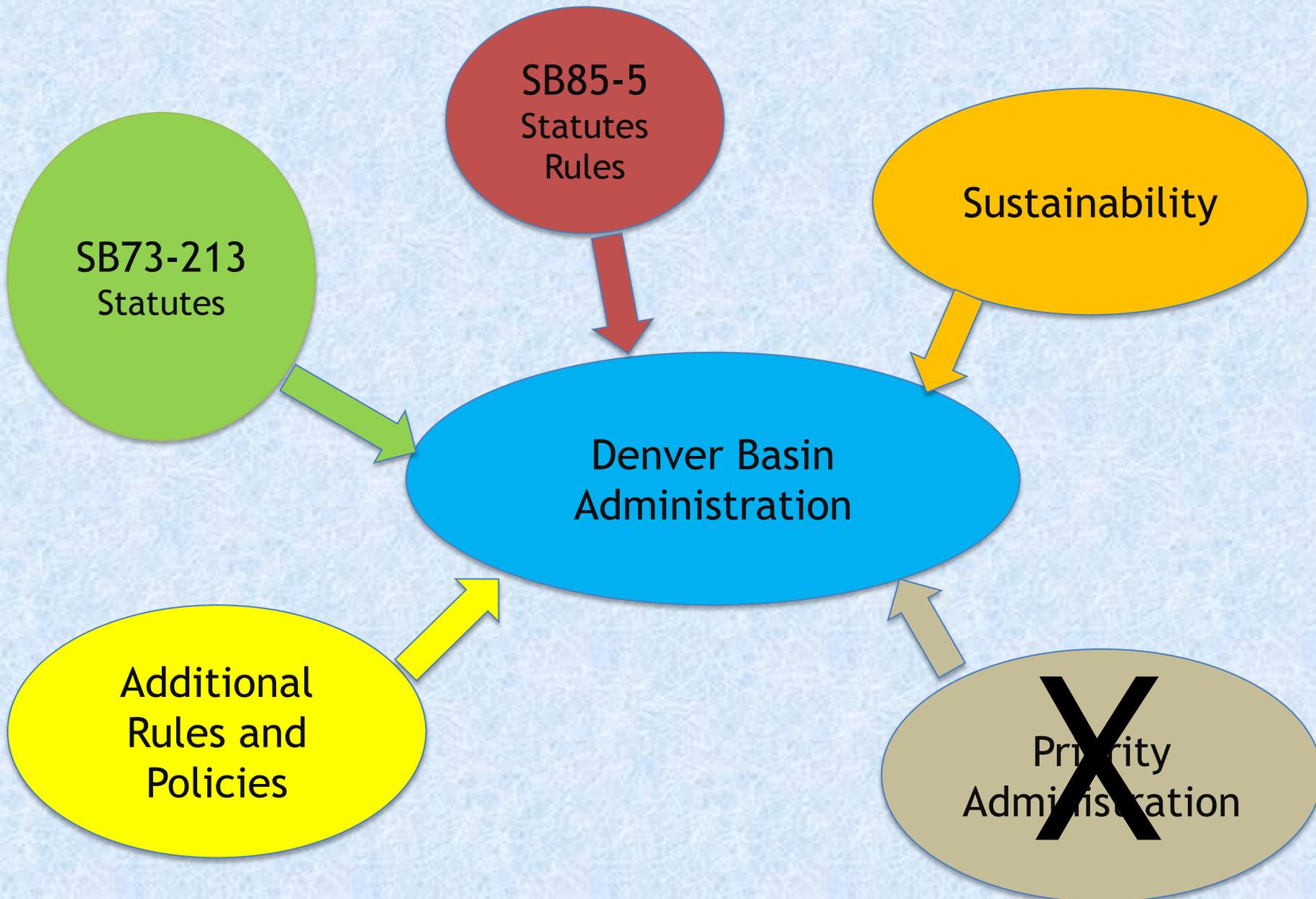
SB73-213
Statutes

Denver Basin
Administration

Additional
Rules and
Policies

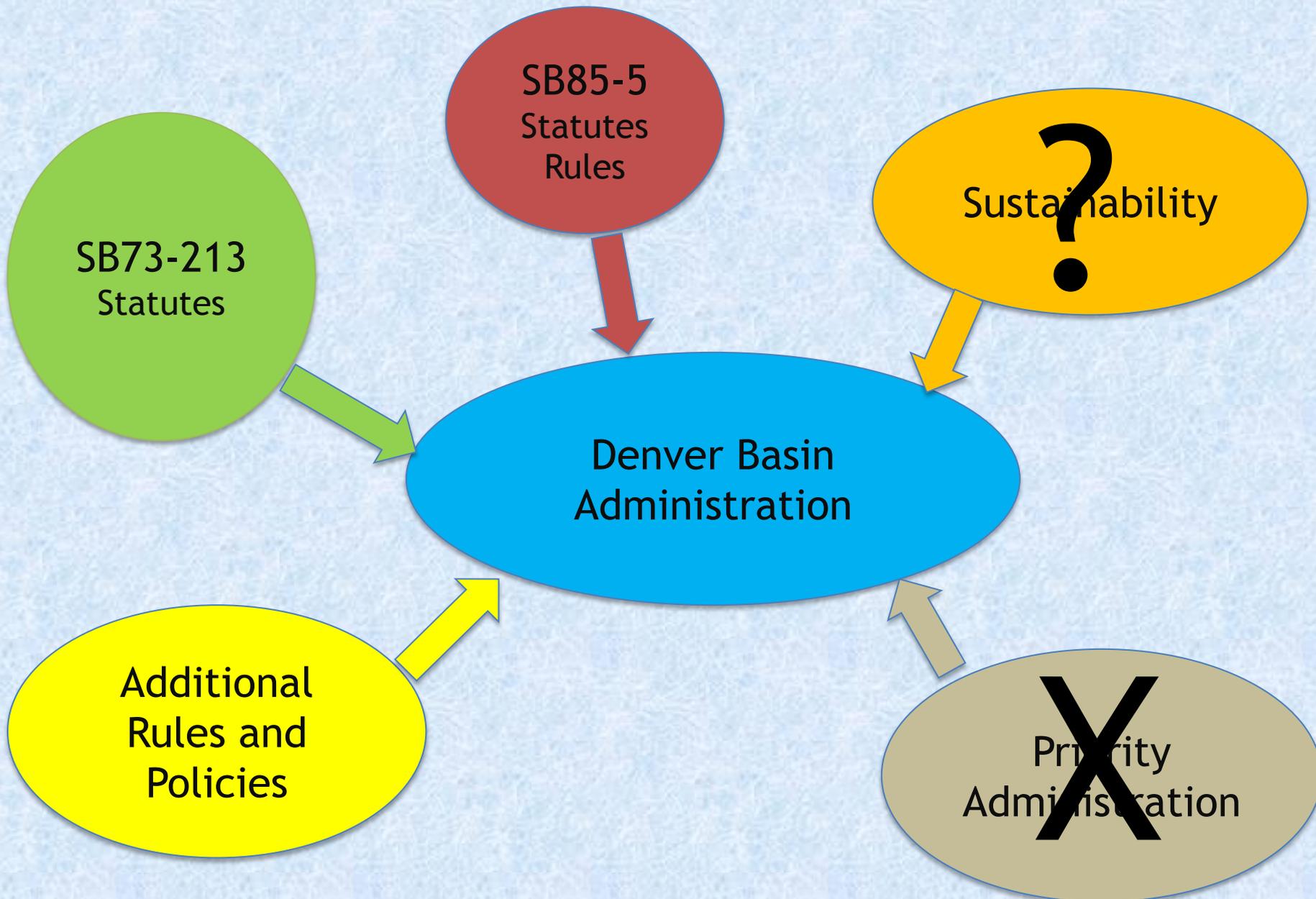
~~Priority
Administration~~





Sustainability

- Allocation
 - Limited to land area
 - One percent per year
- Mined aquifers
 - Finite, nonrenewable, negligible recharge



Interim Water Committee

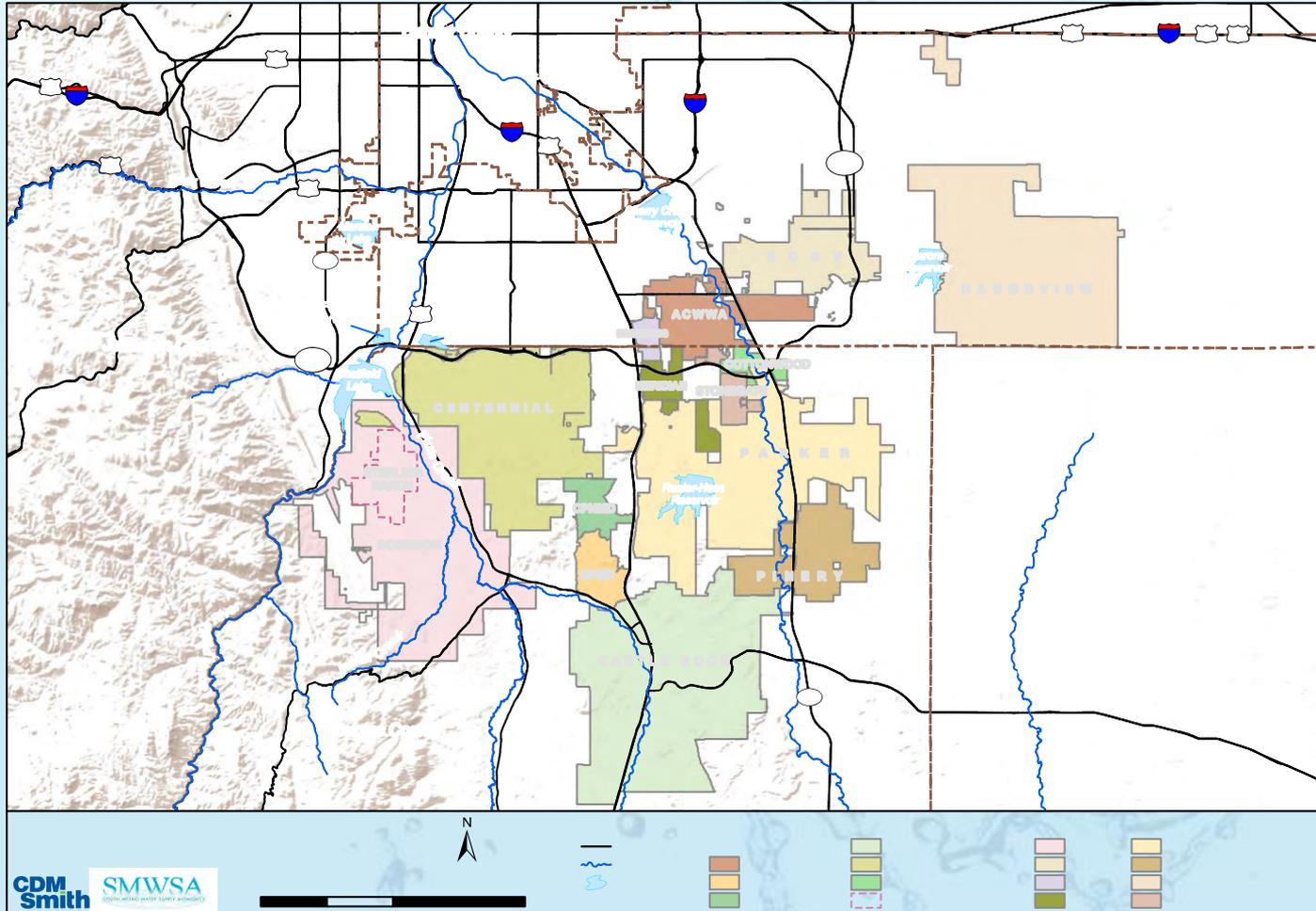
South Metro and the Denver Basin Aquifer

Eric Hecox, Executive Director
South Metro Water Supply Authority

September 4, 2014

SMWSA:

- 14 Members
- Serve 300,000 people
- 80% of Douglas County; 10% of Arapahoe County
- 550,000 people by 2050



Water Supply after Two Forks

- Minimal Local Renewable Sources
 - Nearby Renewable Sources Over-appropriated
 - **Plentiful, high quality, low cost Non-tributary Ground Water**
- ↓
- **Look to Non-tributary Ground Water**

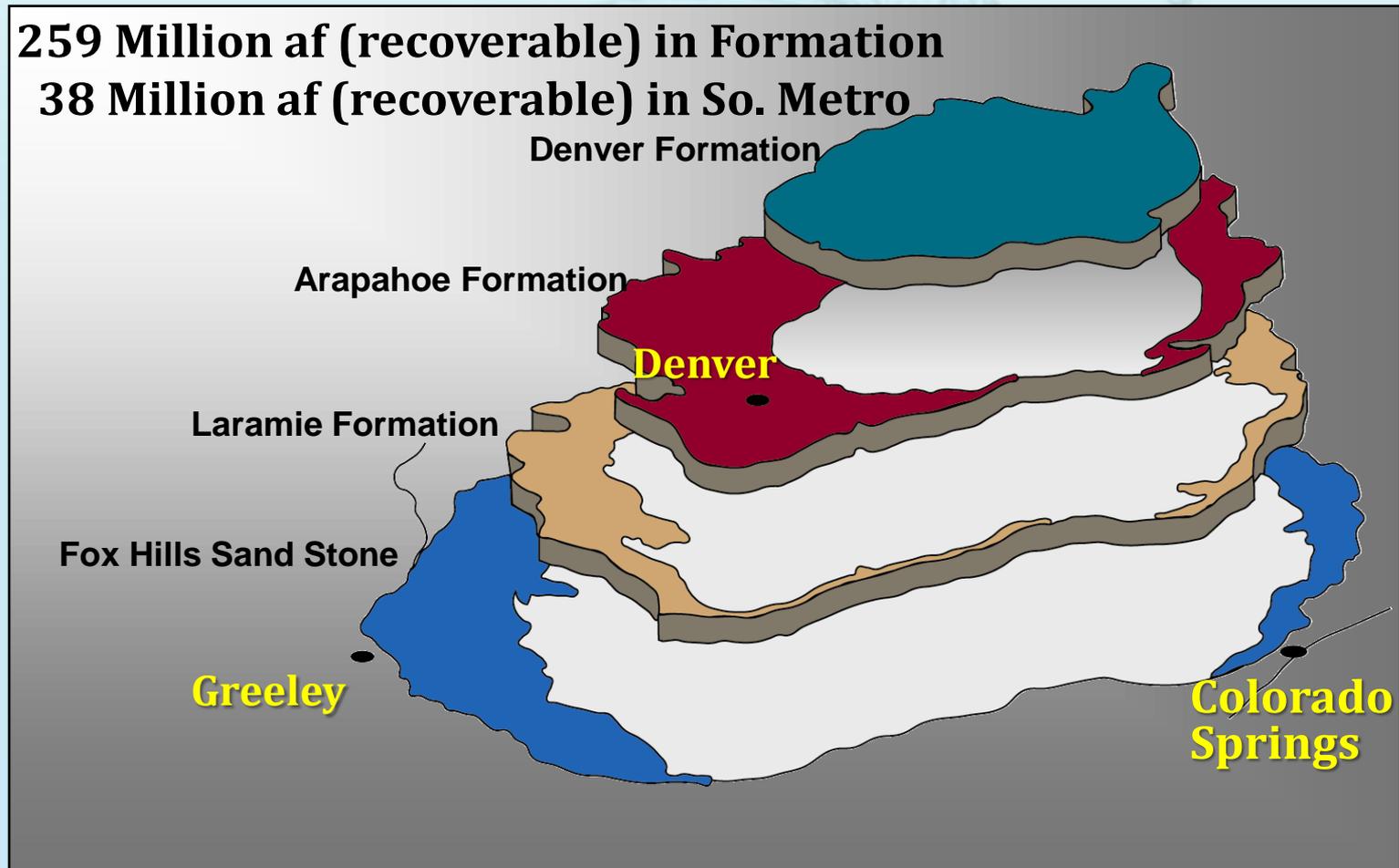


Searching for Ground Water

Rely on a Non-Renewable Resource?

259 Million af (recoverable) in Formation

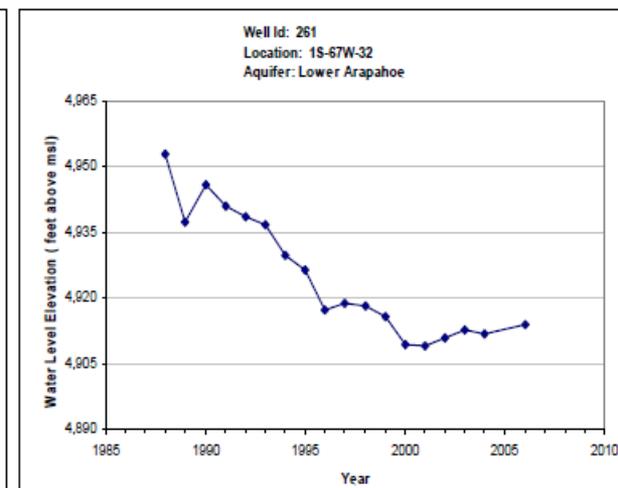
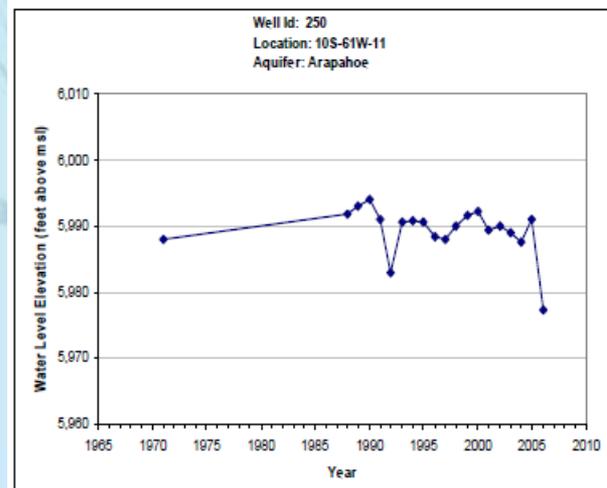
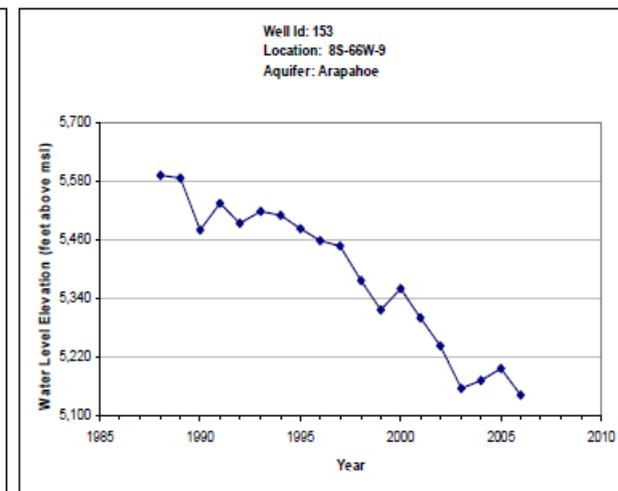
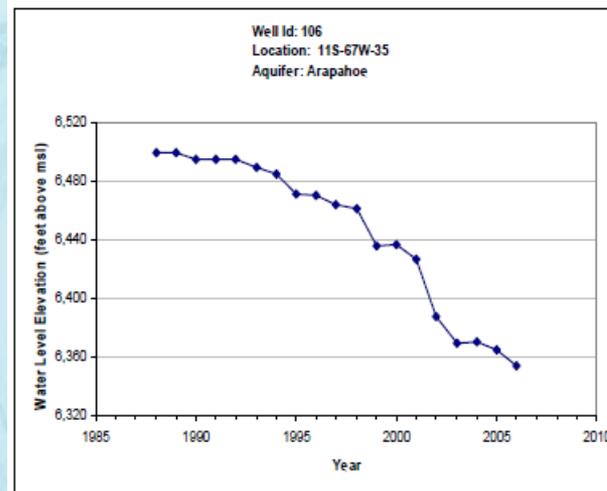
38 Million af (recoverable) in So. Metro



It's not the water it's the pressure!

What Happened?

- Explosive Growth
- Rapidly Declining Aquifers
- Steady Decline in Production

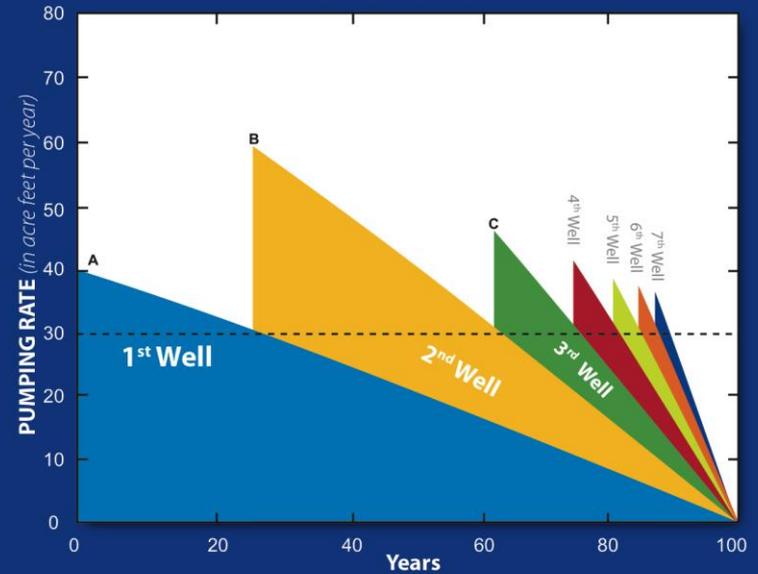


Average Annual Groundwater Level Declines

(DCWRA, 2013)

Denver Basin Aquifer	CDWR (ft. per year)	USGS Model (ft. per year)
Dawson	-5	-1
Denver	-6	-2
Arapahoe	-12	-2
Laramie-Fox Hills	-13	-5

CASCADING REDUCTION IN WELL YIELD



To illustrate the cascading reduction in well yield and requirement to drill more and more wells to maintain a specific production requirement, we reference an example from the US Geological Survey.

Assume that well A produces 40 acre feet per year when initially completed, and it experiences a fixed rate of water level decline that causes the aquifer to be dewatered in 100 years. If the required application needs 30 acre feet per year, well A needs to be augmented in 25 years. So we drill well B, and the combined yield of both wells far surpasses our fixed yield, but the combined well yield decreases more rapidly. In another 27 years a third well (C) is required to maintain the required production capacity. With three wells operating we again exceed our water need, but due to declining water levels and well-to-well interferences it will only be 13 years before a fourth well is needed. You can see from the graph above that this sequence will continue at an ever increasing frequency even though the water level is declining at a constant rate.

In this example, if the cost of constructing and equipping each well is \$ 500,000 then the water cost for the first well is \$267 per acre-foot. Because of reduced total production as more wells are added, the water cost for the sixth well is \$13,500 per acre-foot. This simple example does not include increased operation expenses. Clearly the economics of relying on non-renewable groundwater supplies as a primary resource are not favorable in the long-term.

What's the Real Story?

What's the Real Story?



SOUTH METRO WATER SUPPLY STUDY

Prepared for:

South Metro Water Supply Study Board

December 2003

- South Metro Entities
 - Denver Water
 - Colorado River District
- Colorado Water Conservation Board

Study Recommendations

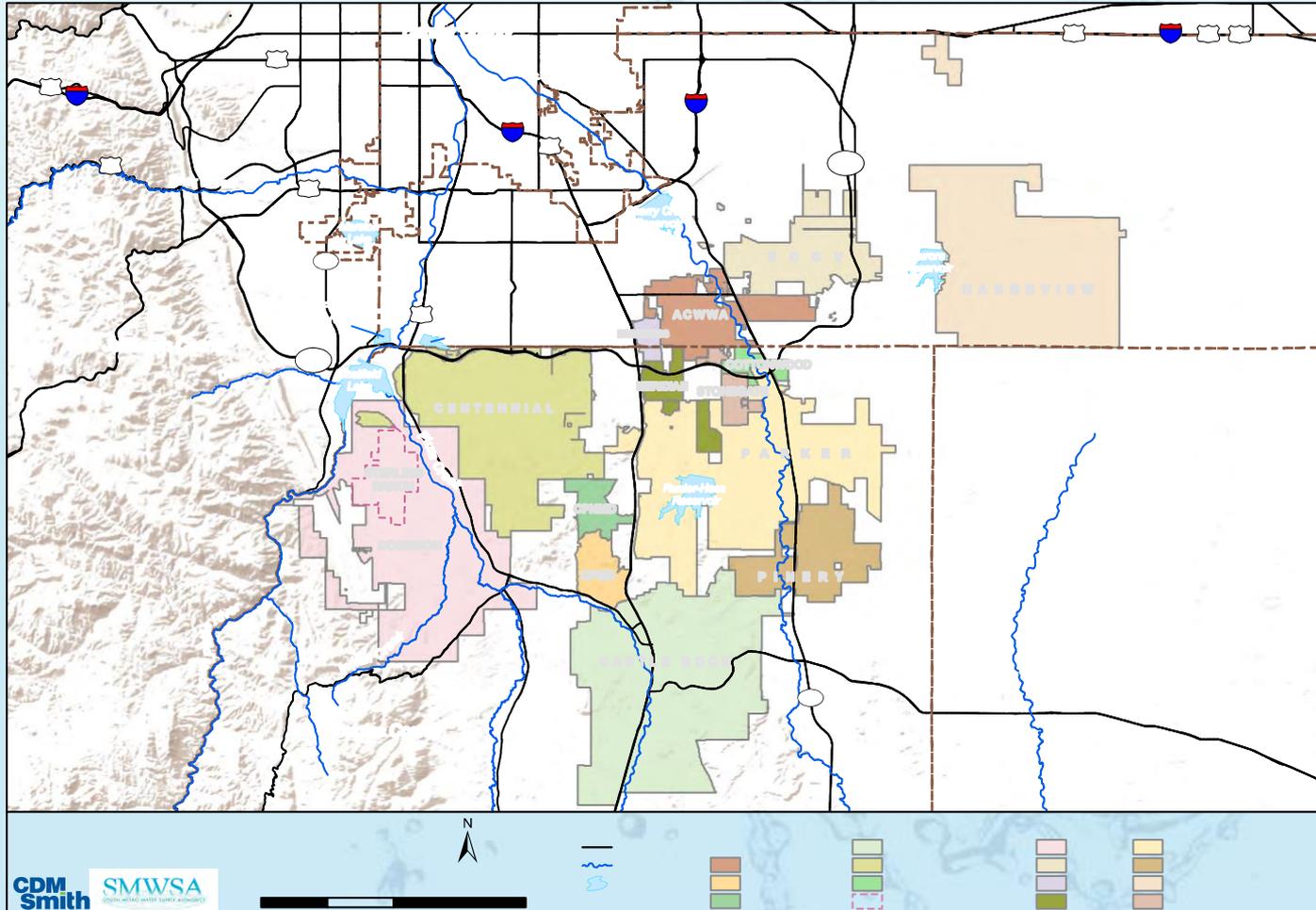
- **Conservation (Demand Reduction)**
- **Maximize reuse**
- **Fully develop local renewable sources**
- **Import Renewable Water (seek regional partnerships)**
- **Consider Conjunctive Use**

Member Projects:

- Reuter-Hess Reservoir
- Castle Rock's Plumb Creek Purification Facility
- ECCV/ACWWA Northern Project

SMWSA Projects:

- WISE Partnership
- Chatfield Reallocation
- ASR Pilot Project



-Regional Master Plan Update-

ASR Efforts

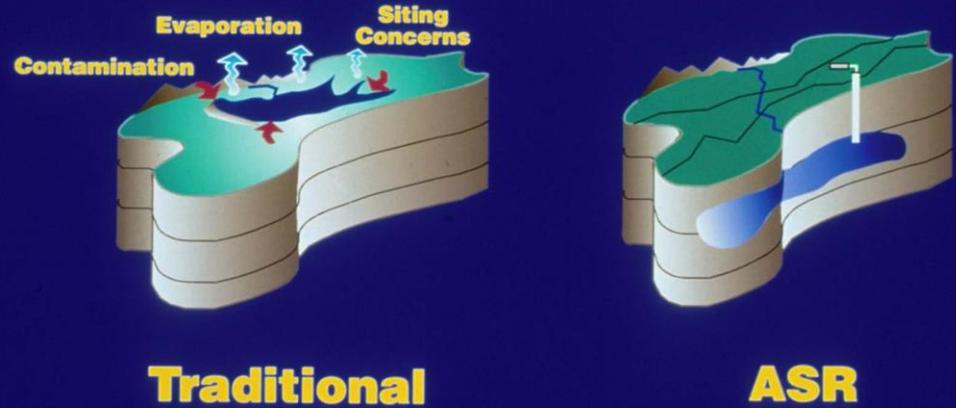
Centennial/Highlands Ranch

- Successful implementation since 1994
- 25 wells currently equipped
- Accumulated Injection – 14,095af (nearly 1-yr supply)

Current Pilot Projects

- SMWSA
- Castle Rock
- ECCV
- Denver Water

Aquifer Storage And Recovery (ASR) May Provide Alternative Storage



Highlands Ranch, CO
ASR History af/year

