

Mining Oil and Gas Well Integrity Data in Colorado and New Mexico



Greg Lackey

Gregory.Lackey@Colorado.edu

5/18/2018

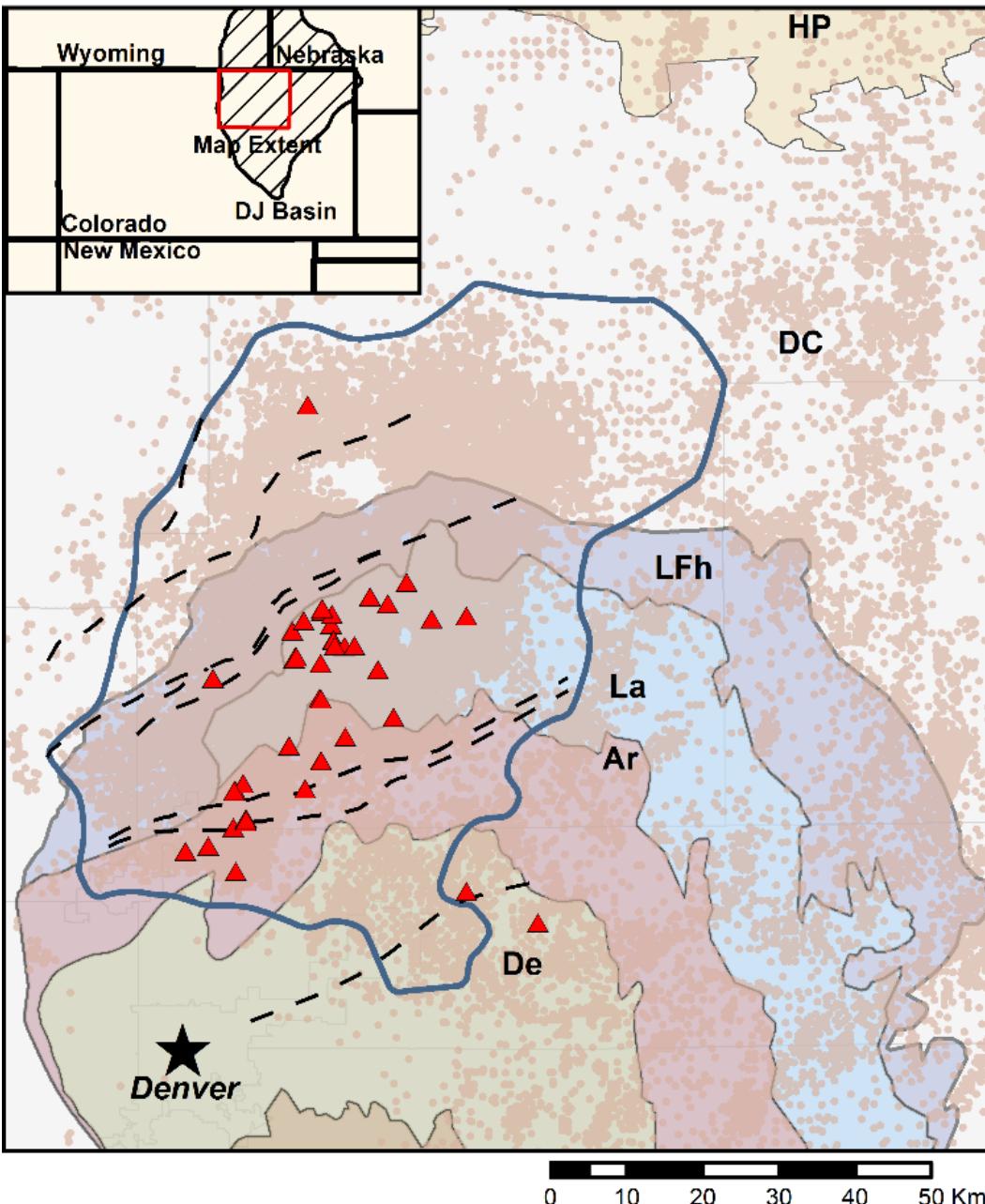


University of Colorado **Boulder**

AirWaterGas



Wattenberg Field



4th largest oil field
9th largest gas field

Stray gas contamination:
Thermogenic CH₄
42 water wells
32 cases
11 “culprit” oil and gas wells

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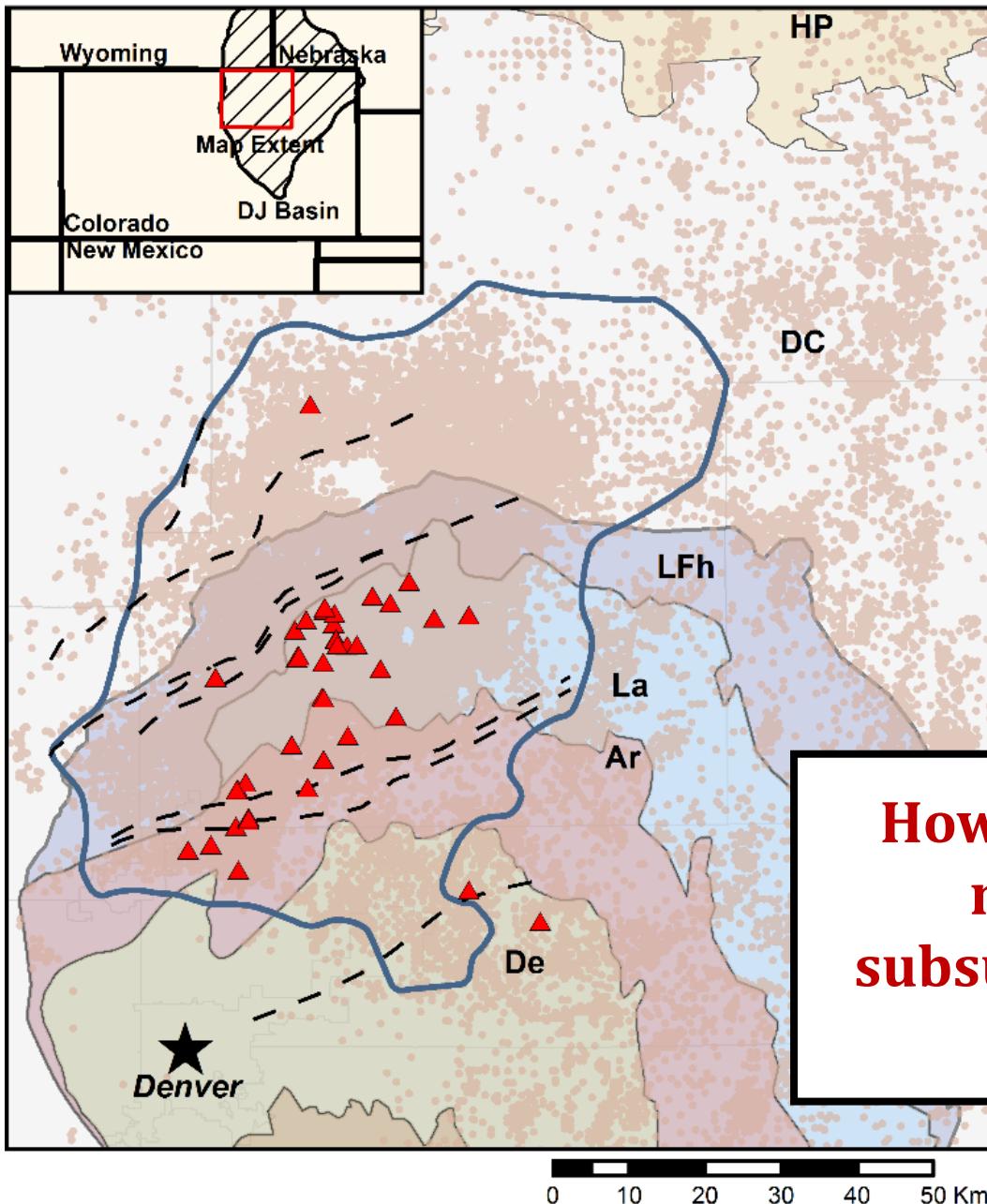
Groundwater methane in relation to oil and gas development and shallow coal seams in the Denver-Julesburg Basin of Colorado

Owen A. Sherwood^a, Jessica D. Rogers^b, Greg Lackey^b, Troy L. Burke^b, Stephen G. Osborn^c, and Joseph N. Ryan^b

^aInstitute of Arctic and Alpine Research, University of Colorado, Boulder, CO 80309; ^bDepartment of Civil, Environmental and Architectural Engineering, University of Colorado, Boulder, CO 80309; and ^cDepartment of Geological Sciences, California State Polytechnic University, Pomona, CA 91768

Edited by Peter H. Gleick, Pacific Institute for Studies in Development, Environment, and Security, Oakland, CA, and approved June 7, 2016 (received for review November 24, 2015)

Wattenberg Field



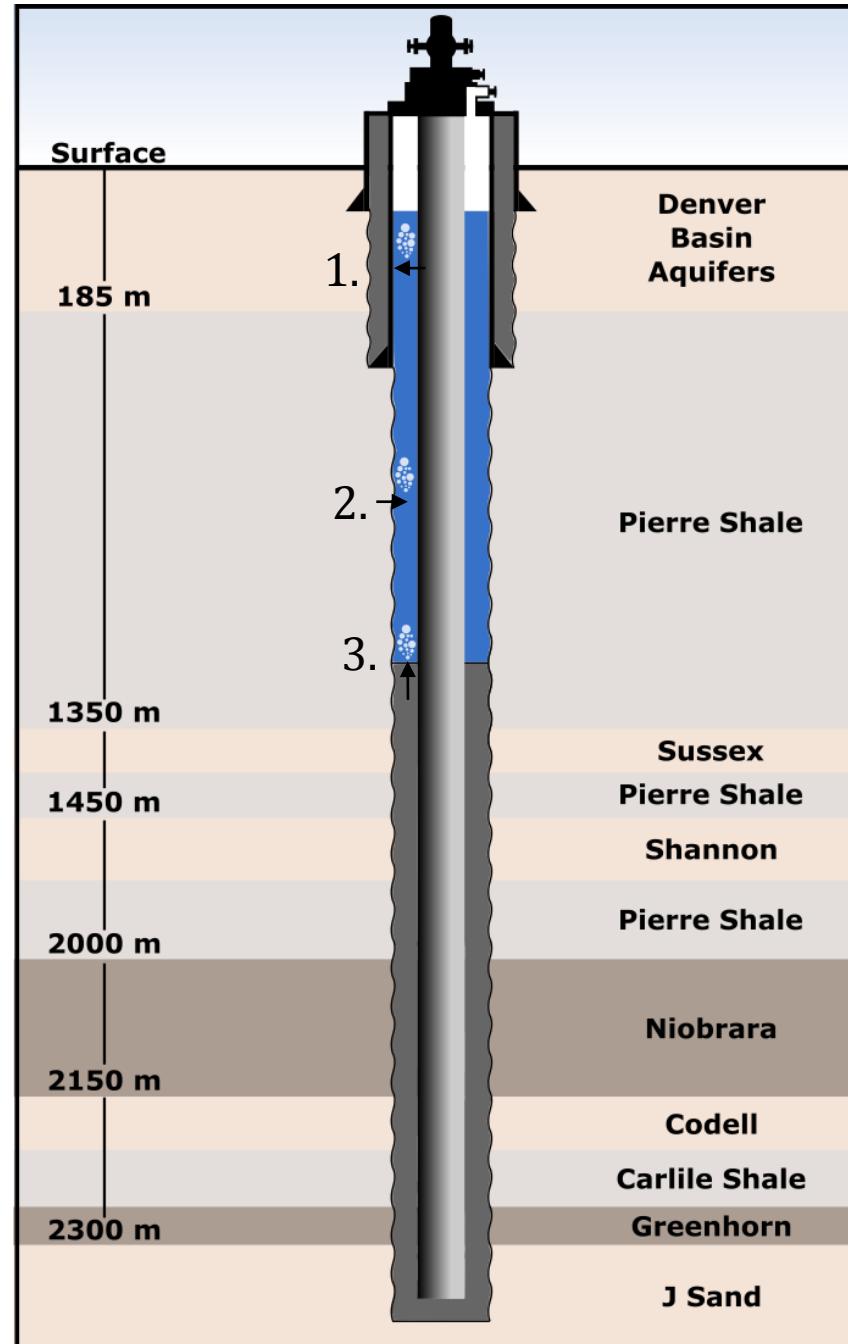
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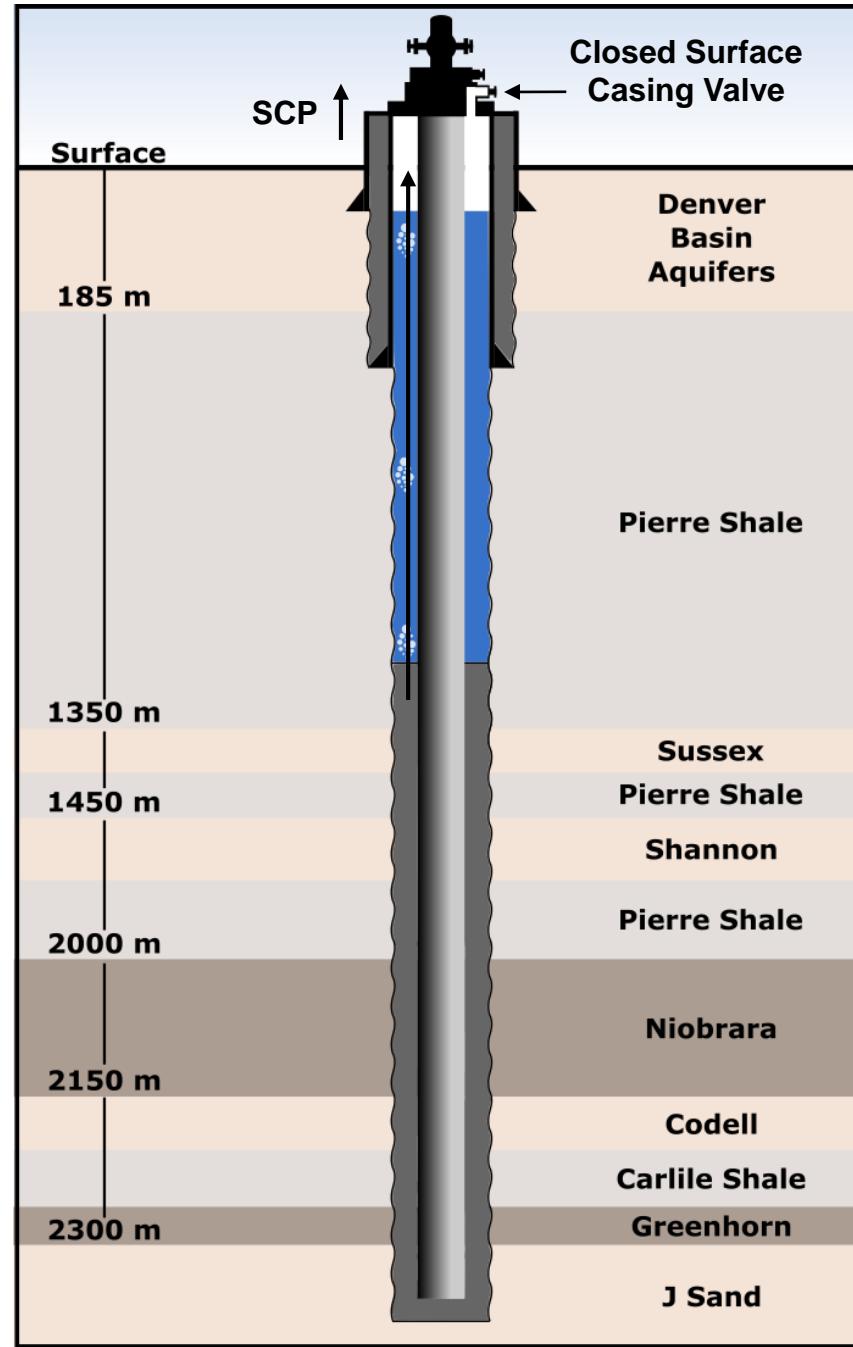
**How did thermogenic stray gas
migrate into the shallow
subsurface through these culprit
wells?**

Well Leakage

1. Casing leak
2. Unknown intermediate
3. Faulty cement seal or improper cement coverage

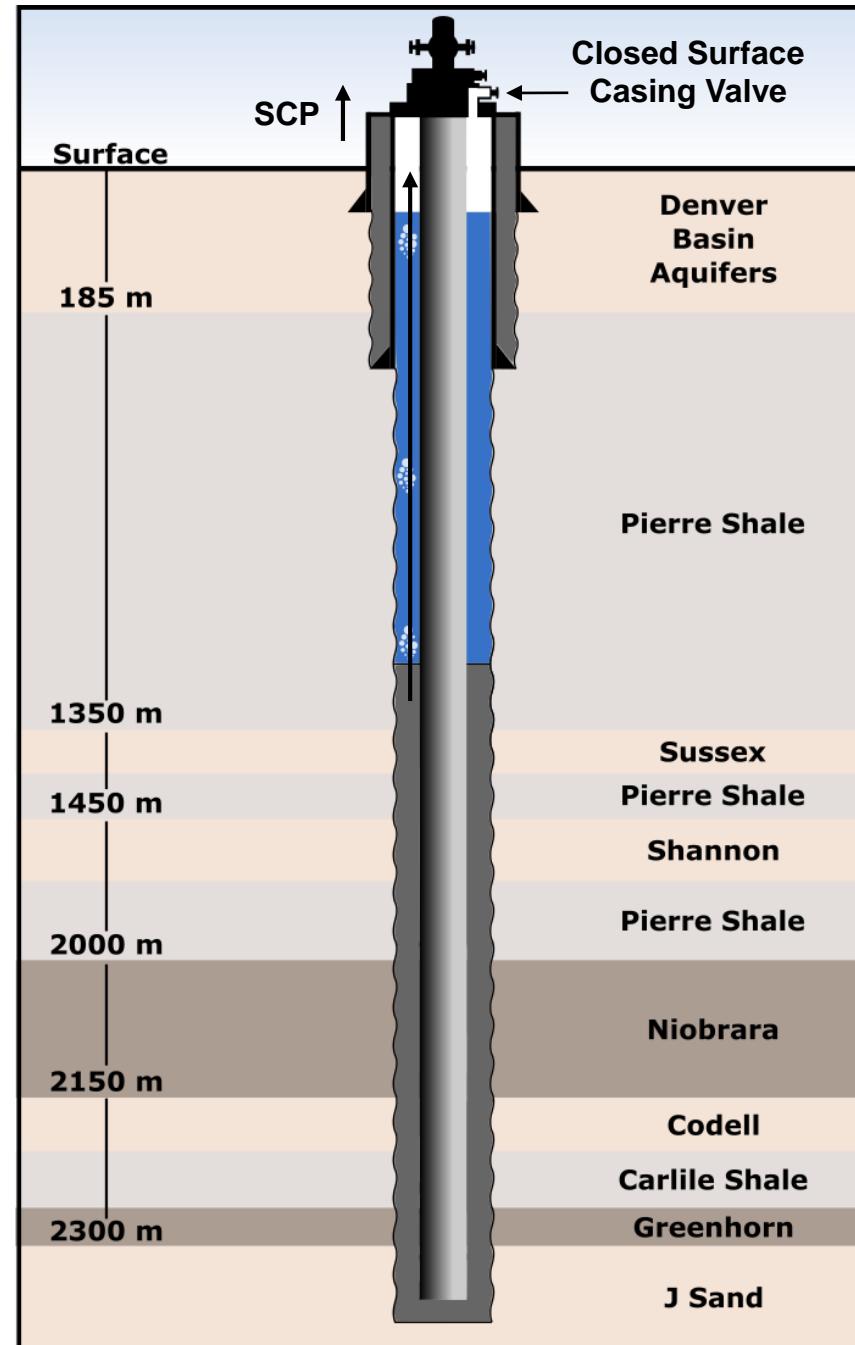


Sustained Casing Pressure (SCP)



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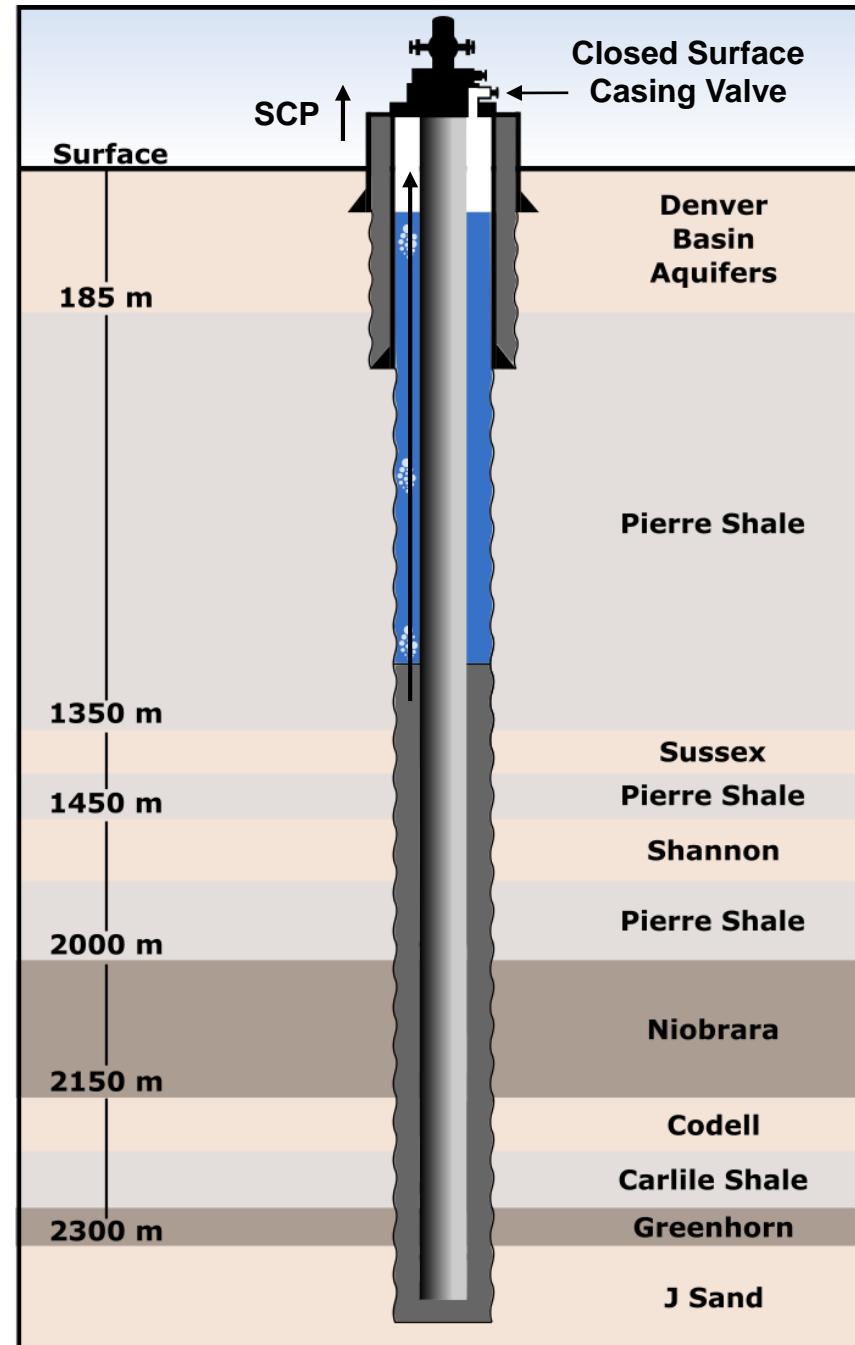
Sustained annular pressure (SAP),
bradenhead pressure, surface
casing vent flow (SCVF)



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Should be no SCP in a properly
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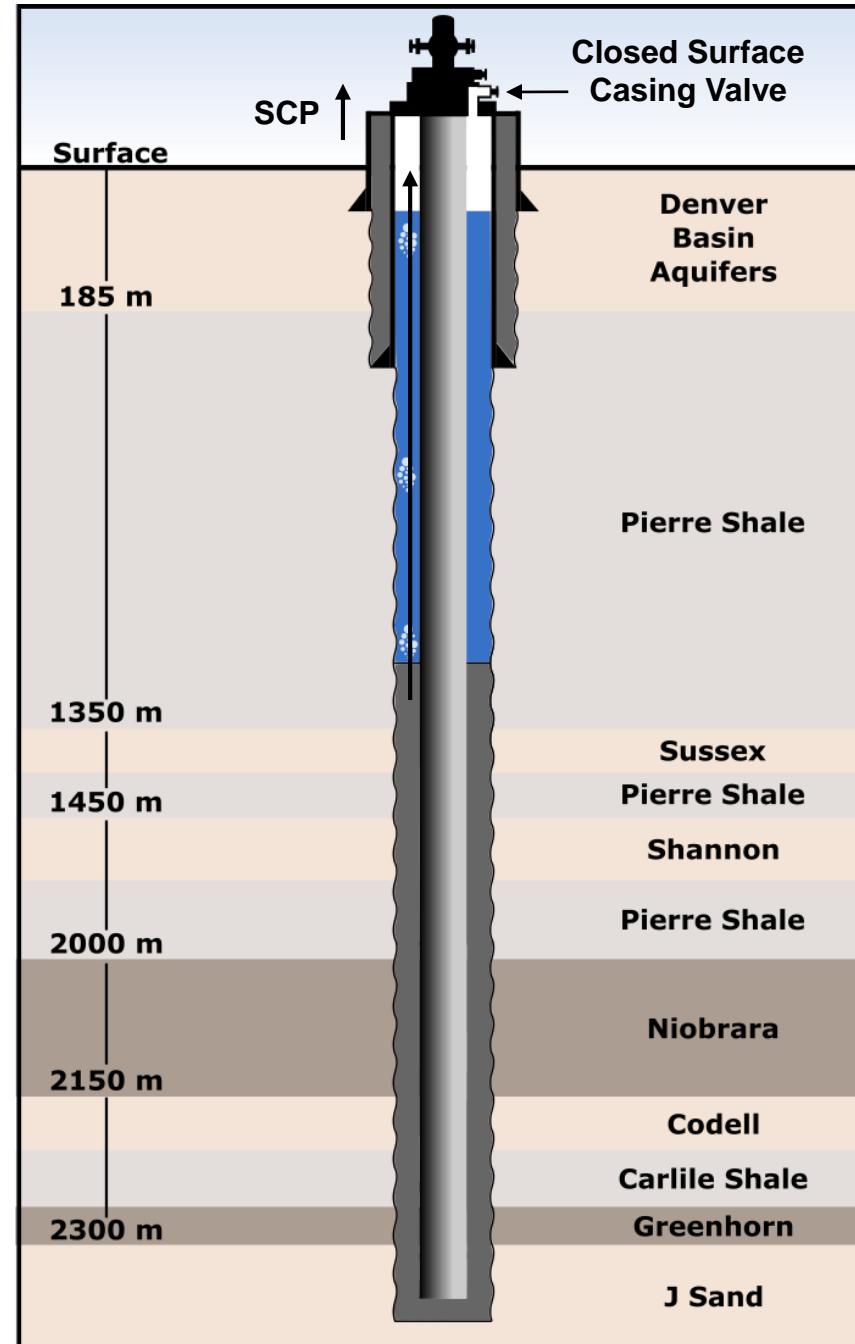


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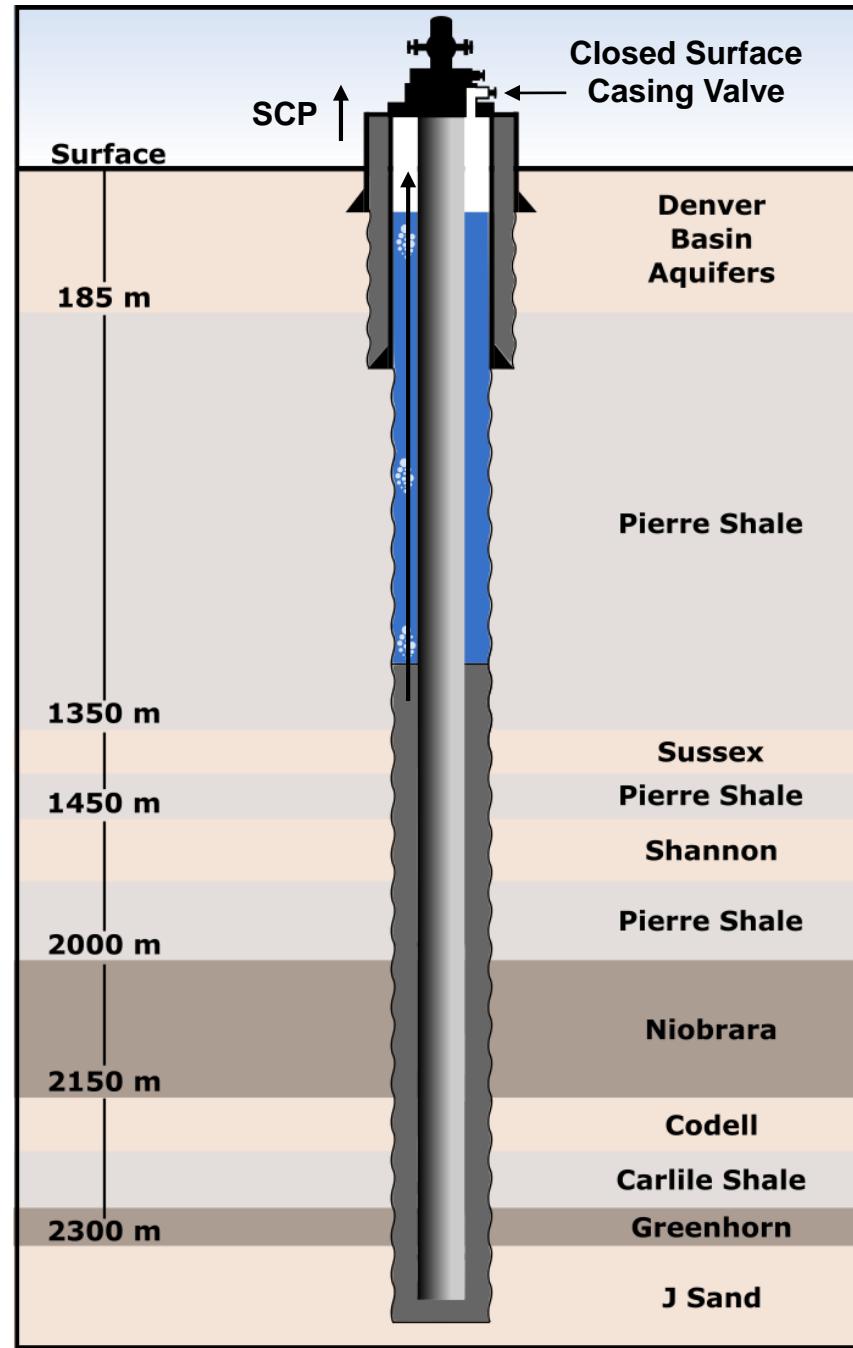
Sustained annular pressure (SAP),
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Should be no SCP in a properly
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**Sustained casing pressure is an
easily measured gauge of well
integrity, but is poorly
documented**

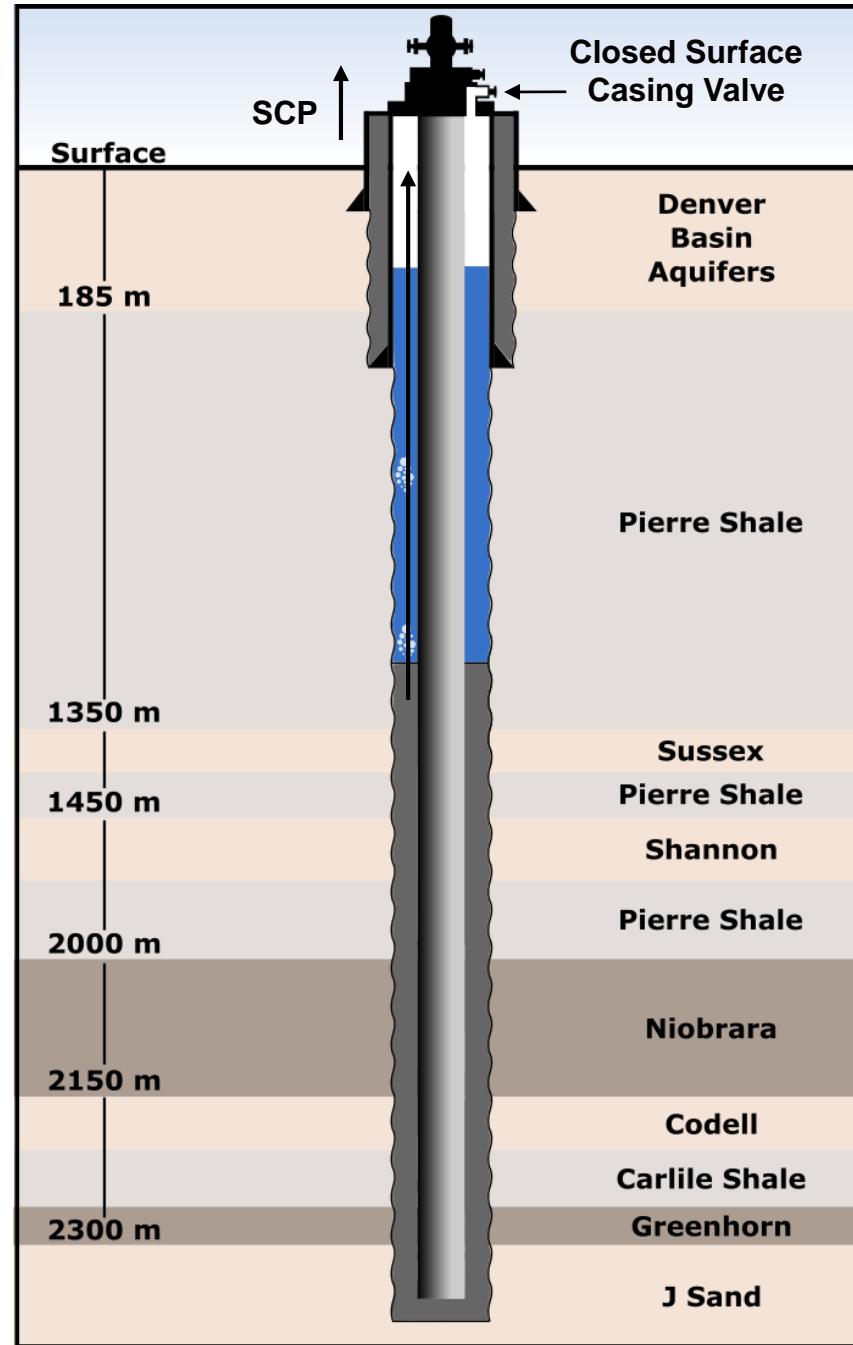


Not all wells that develop SCP induce stray gas migration



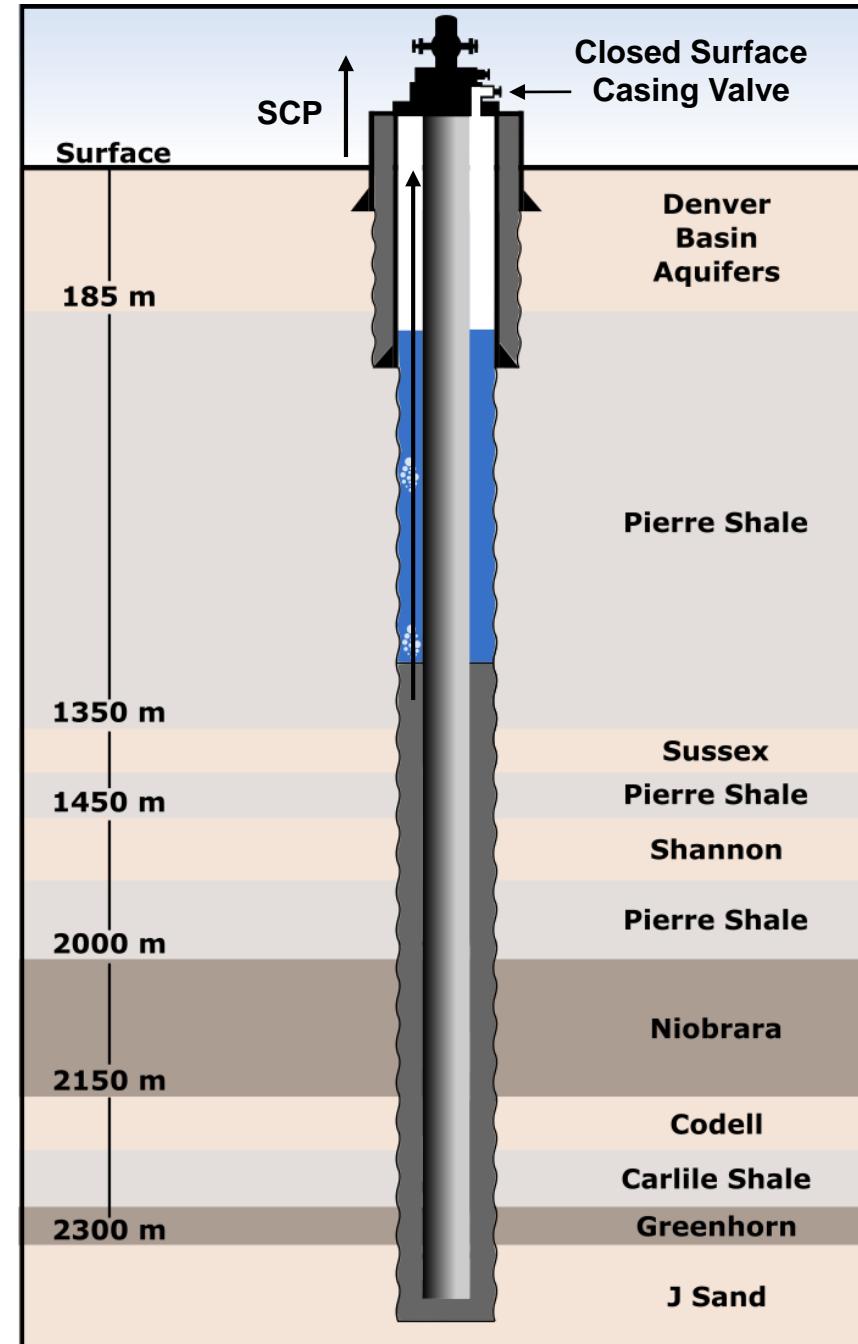
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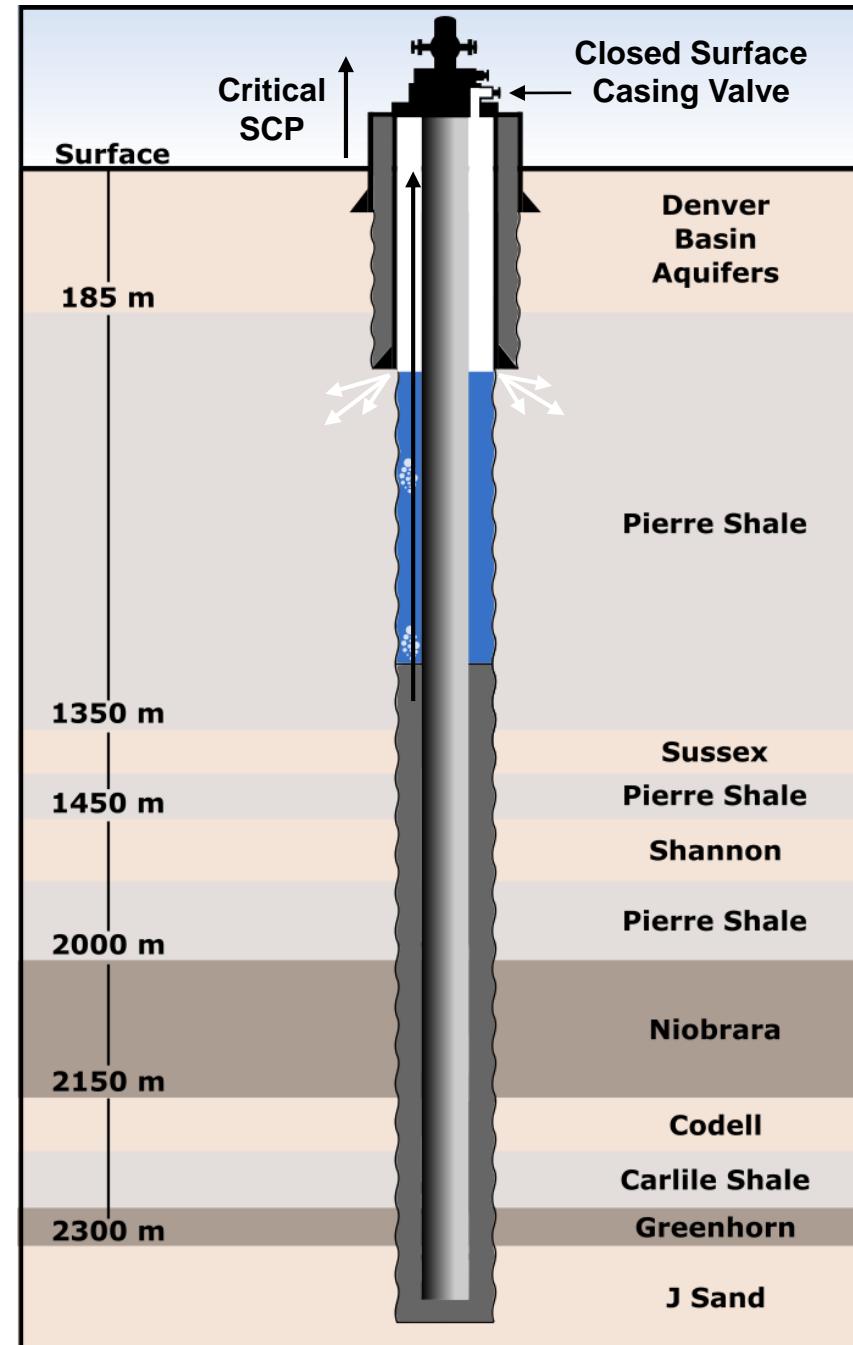
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When SCP = formation fluid pressure at bottom of surface casing stray gas migration can be induced

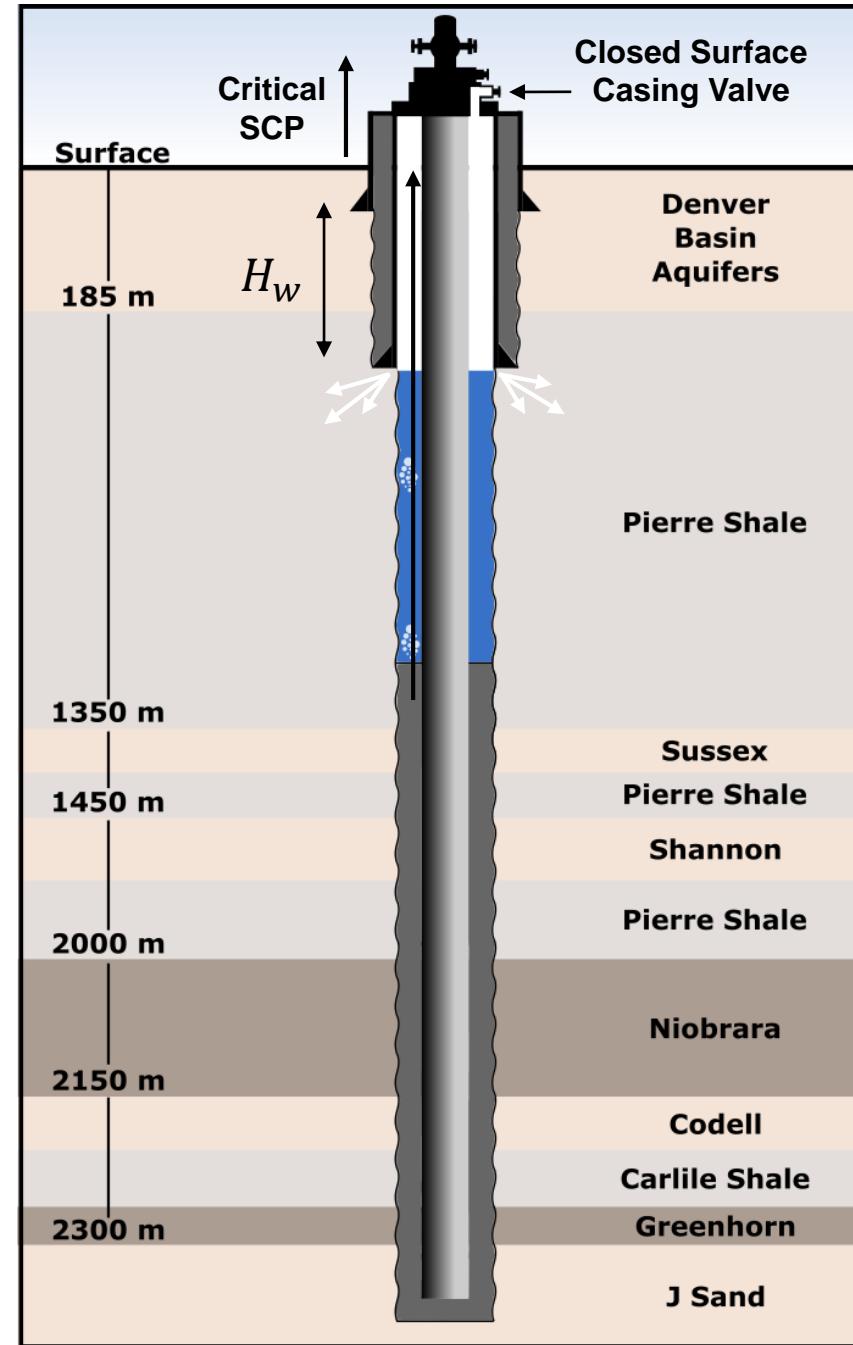


Not all wells that develop SCP induce stray gas migration

As pressure builds annular liquid is displaced

When SCP = formation fluid pressure at bottom of surface casing stray gas migration can be induced

Critical sustained casing pressure is a well-specific physically meaningful indicator of stray gas migration



Bradenhead Testing

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FORM 17 <small>Rev 8/99</small>	State of Colorado Oil and Gas Conservation Commission 1120 Lincoln Street, Suite 801, Denver, Colorado 80203 (303) 894-2100 Fax: (303) 894-2109	 FOR OGCC USE ONLY																																																																								
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Bradenhead Testing

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STEP 4: INTERMEDIATE CASING TEST							
Buried valve? <input type="checkbox"/> Yes <input type="checkbox"/> No	Confirmed open? <input type="checkbox"/> Yes <input type="checkbox"/> No	Elapsed Time (Min:Sec)	Fm. Tubing:	Fm. Tubing:	Production Casing PSIG	Intermediate Casing PSIG	Intermediate Flow:
With gauges monitoring production casing and tubing pressures, open the intermediate casing valve. Record pressures at five minute intervals. Characterize flow in							

Bradenhead Testing

- Pressure measured as found on surface casing
- Instantaneous pressure measured at the end of the test
- Filed as text-based PDFs that can be mined using Python

[Click here to reset form](#)

FORM 17 Rev 8/99

State of Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801, Denver, Colorado 80203 (303) 894-2100 Fax: (303) 894-2109

BRADENHEAD TEST REPORT

Step 1. Record all tubing and casing pressures as found.
Step 2. Sample now, if intermediate or surface casing pressure >25 psig. In sensitive areas, 1 psig.
Step 3. Conduct Bradenhead test.
Step 4. Conduct Intermediate casing test.
Step 5. Send report to BLM within 30 days and to OGCC within 10 days. Include wellbore diagram if not previously submitted or if wellbore configuration has changed since prior program. Attach gas and liquid analyses if sampled.

1. OGCC Operator Number: _____ 11. Date of Test: _____
2. Name of Operator: _____ 12. Well Status: Flowing Shut in
 Gas Lift Pumping Injection
 Clock/Intermittent
 Plunger Lift
3. BLM Lease No: _____
4. API Number: _____ 5. Multiple completion? Yes No
6. Well Name: _____ Number: _____
7. Location (CtrQtr, Sec, Twp, Rng, Meridian): _____
8. County: _____ 9. Field Name: _____
10. Minerals: Fee State Federal Indian
13. Number of Casing Strings: _____
 Two Three Liner?
11. Date of Test: _____
12. Well Status: Flowing Shut in
 Gas Lift Pumping Injection
 Clock/Intermittent
 Plunger Lift
13. Number of Casing Strings: _____
 Two Three Liner?
14. **STEP 1: EXISTING PRESSURES**
Record all pressures as found Surface Casing:
Tubing: _____ Fm: _____ Tubing: _____ Fm: _____ Prod. Casing: _____ Fm: _____ Intermediate Casing: _____ Fm: _____
15. **STEP 2: See instructions above.**

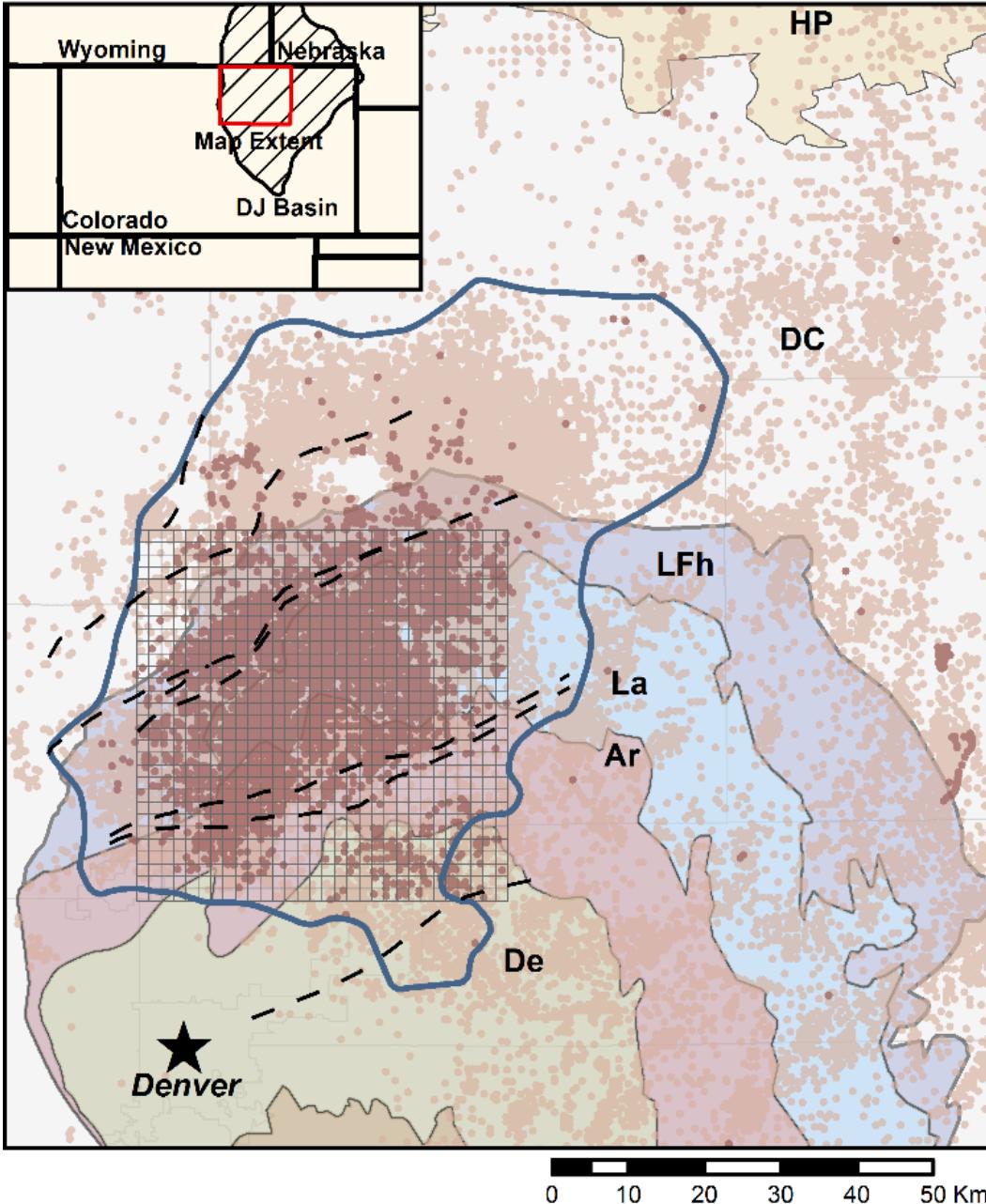
16. **STEP 3: BRADENHEAD TEST**

Buried valve? Yes No Confirmed open? Yes No
With gauges monitoring production, intermediate casing and tubing pressures, open surface casing (bradenhead) valve (if no intermediate casing, monitor only the production casing and tubing pressures.) Record pressures at five minute intervals. Define characteristics of flow in "Bradenhead Flow" column using letter designations below:
O = No Flow; C = Continuous; D = Down to 0; V = Vapor
H = Water H₂O; M = Mud; W = Whisper; S = Surge; G = Gas
BRADENHEAD SAMPLE TAKEN?
 Yes No Gas Liquid
Character of Bradenhead fluid: Clear Fresh
 Sulfur Salty Black
 Other: (describe)
Sample cylinder number: _____
Note instantaneous Bradenhead PSIG at end of test: > _____

17. **STEP 4: INTERMEDIATE CASING TEST**

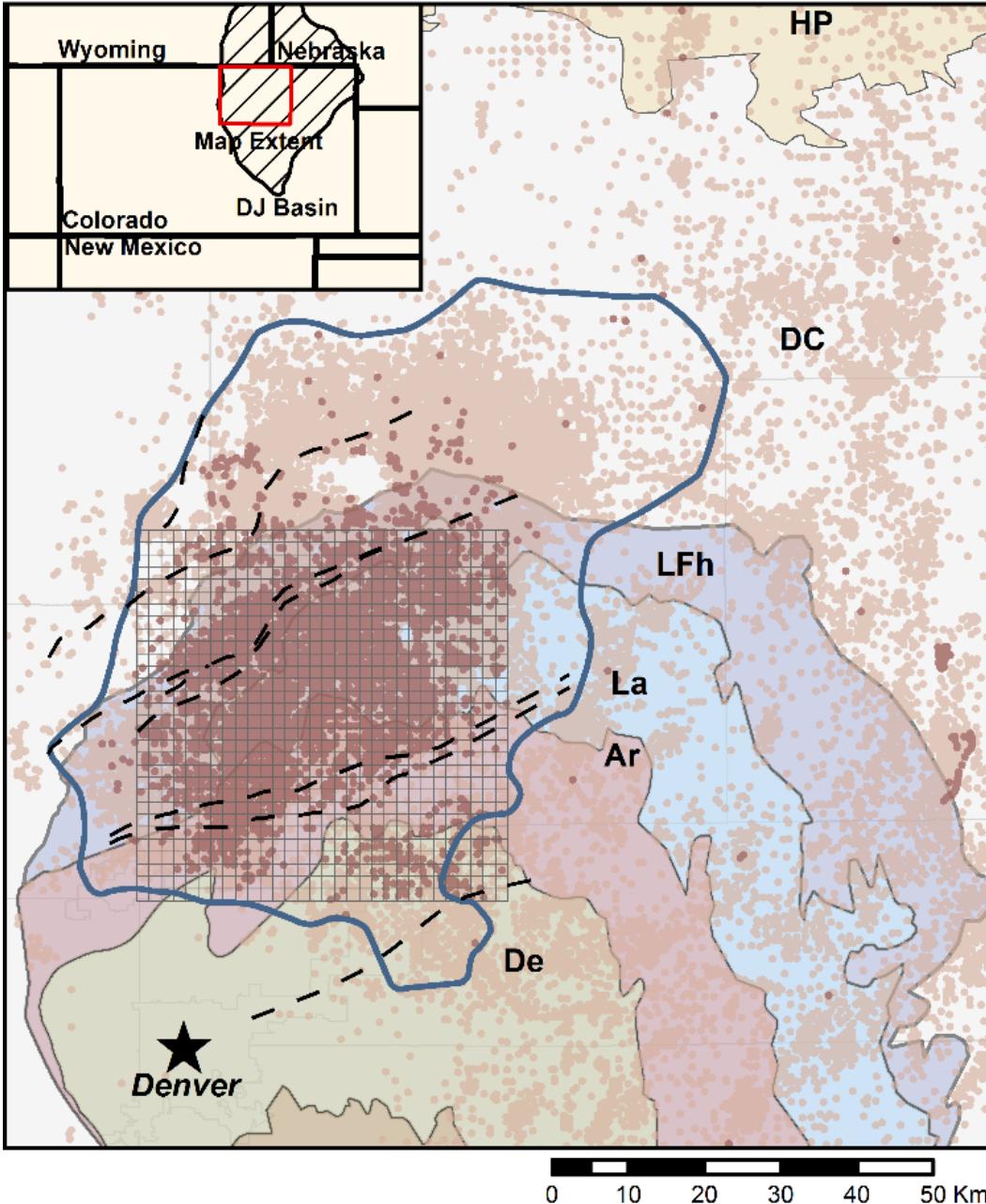
Buried valve? Yes No Confirmed open? Yes No
With gauges monitoring production casing and tubing pressures, open the intermediate casing valve. Record pressures at five minute intervals. Characterize flow in

First Well Integrity Study



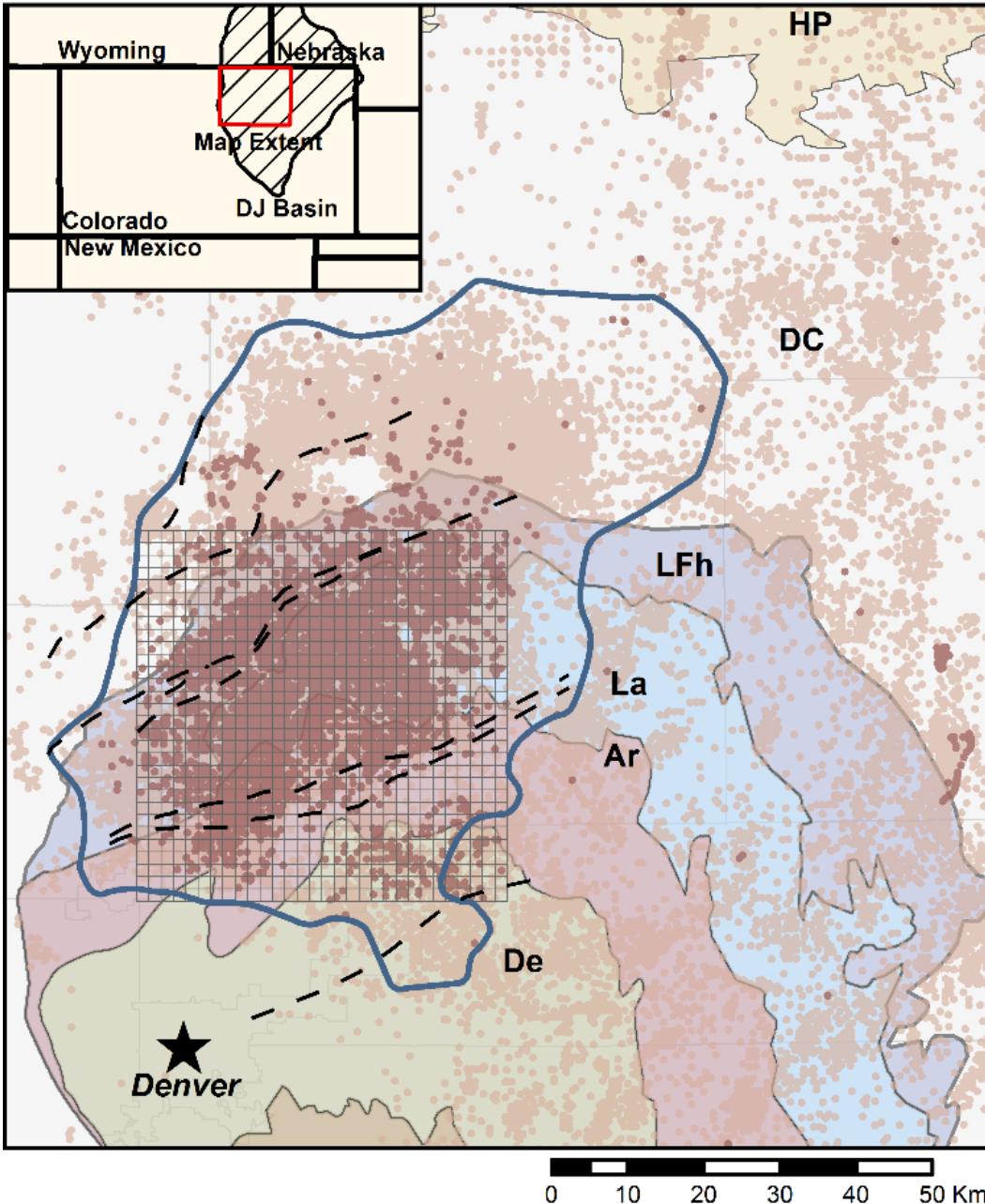
2010 bradenhead testing
policy establishes
Wattenberg Test Zone (WTZ)

First Well Integrity Study



2010 bradenhead testing
policy establishes
Wattenberg Test Zone (WTZ)
3,923 readable bradenhead
tests (after QA/QC)

First Well Integrity Study

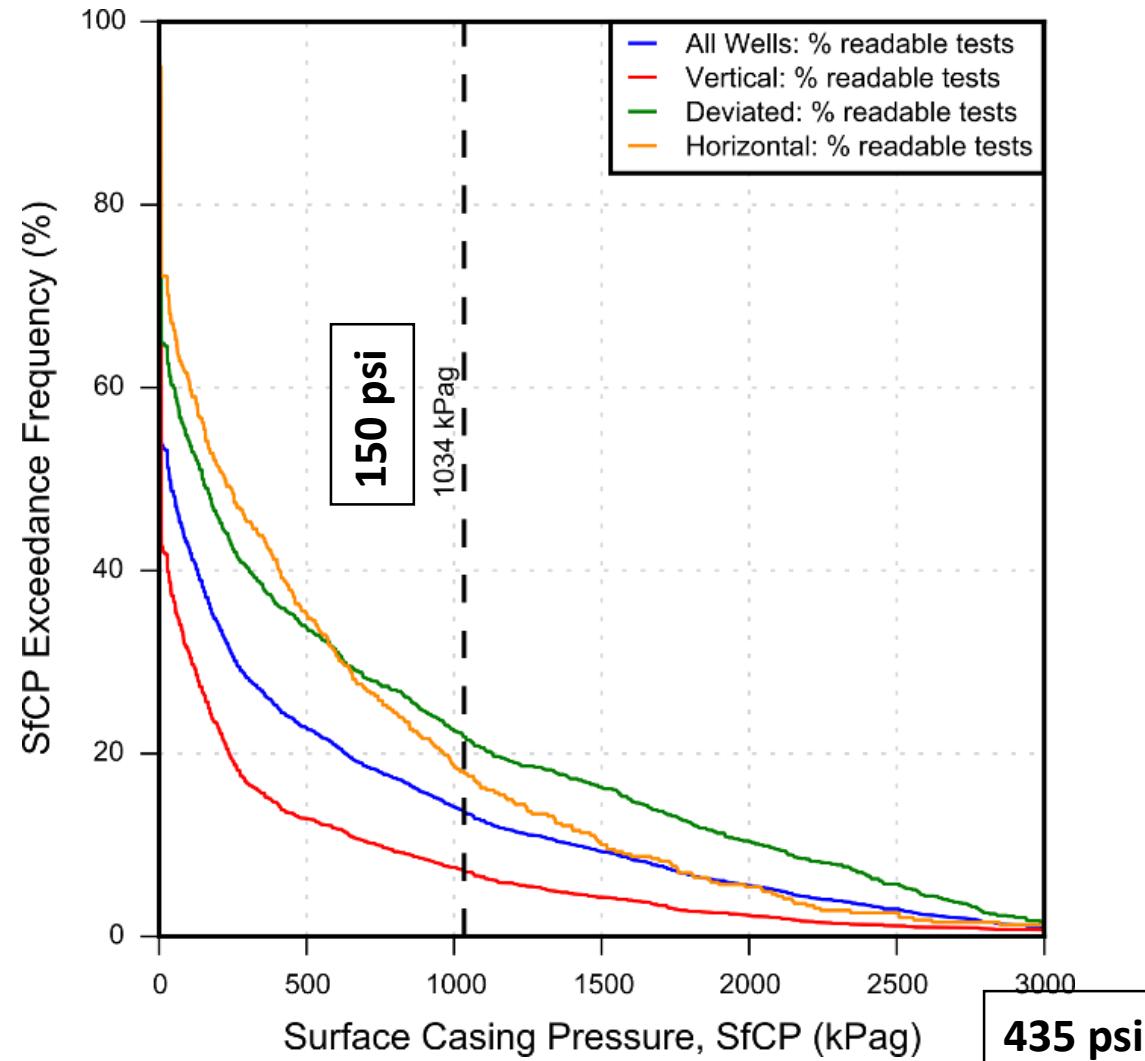


2010 bradenhead testing
policy establishes
Wattenberg Test Zone (WTZ)

3,923 readable bradenhead
tests (after QA/QC)

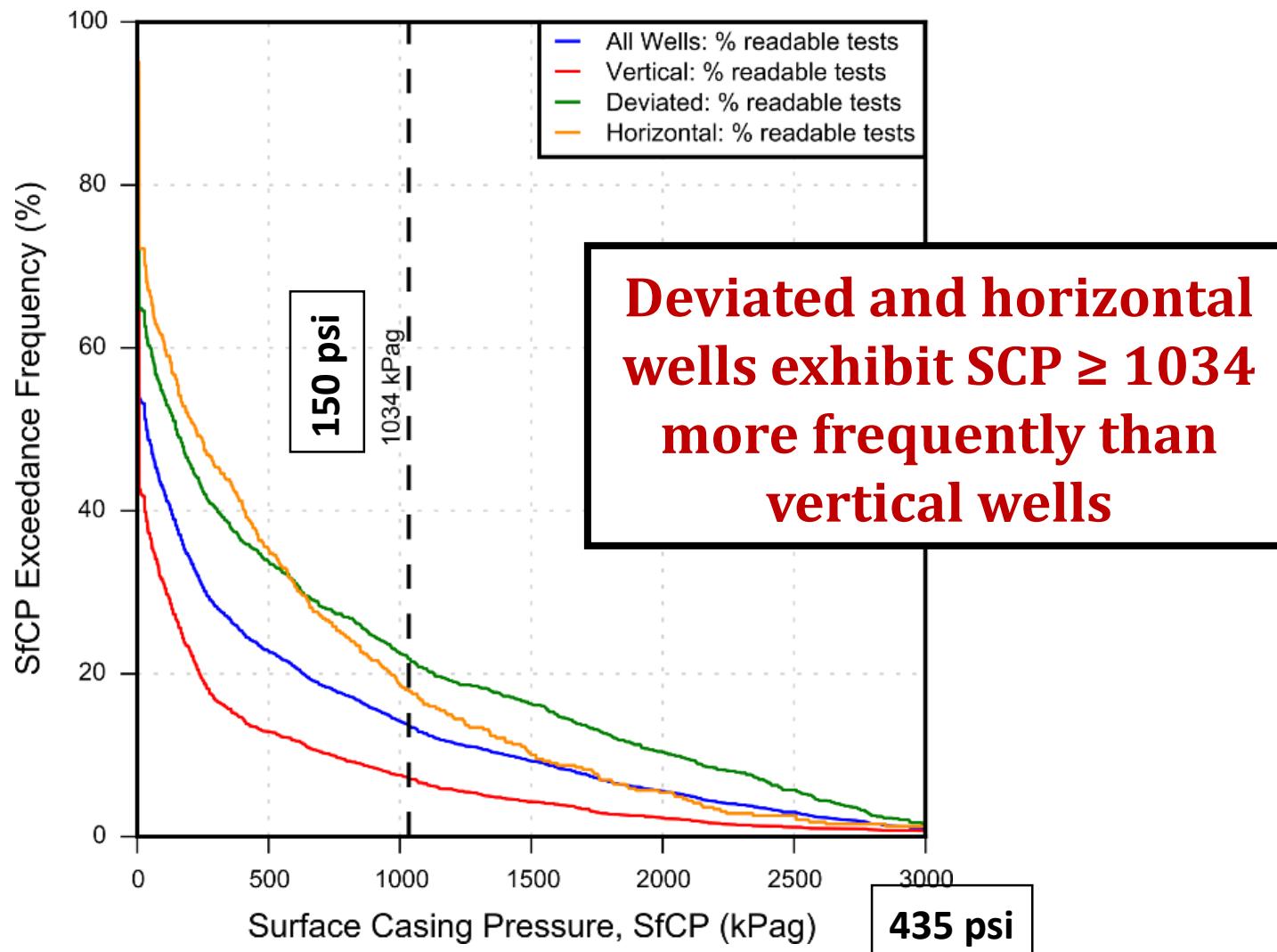
Paired with QA/QC well
construction data

How Many Wells Have SCP?

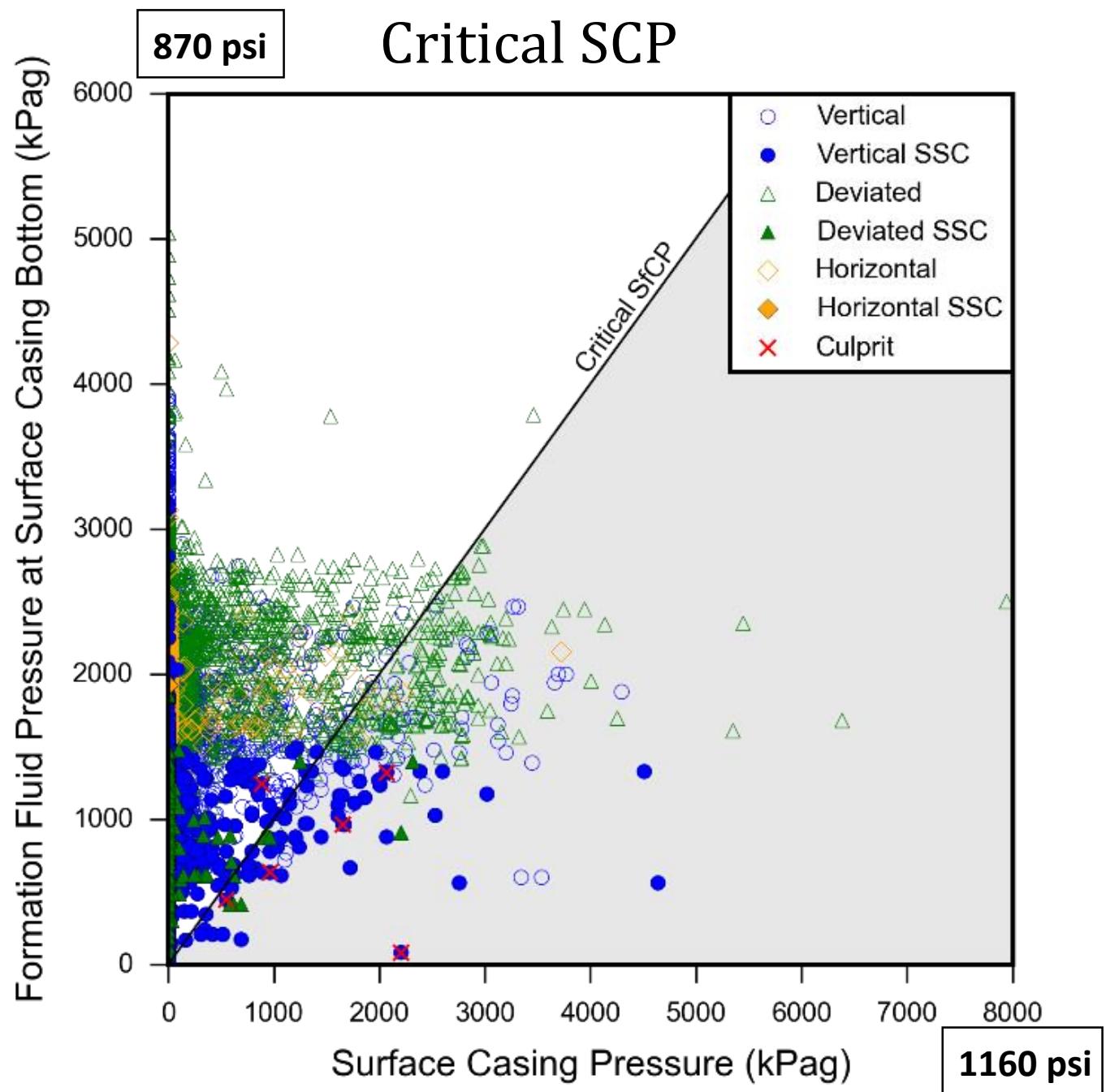


All Wells (13.8%), Vertical Wells (7.4%), Deviated Wells (21.9%), and Horizontal Wells (18%)

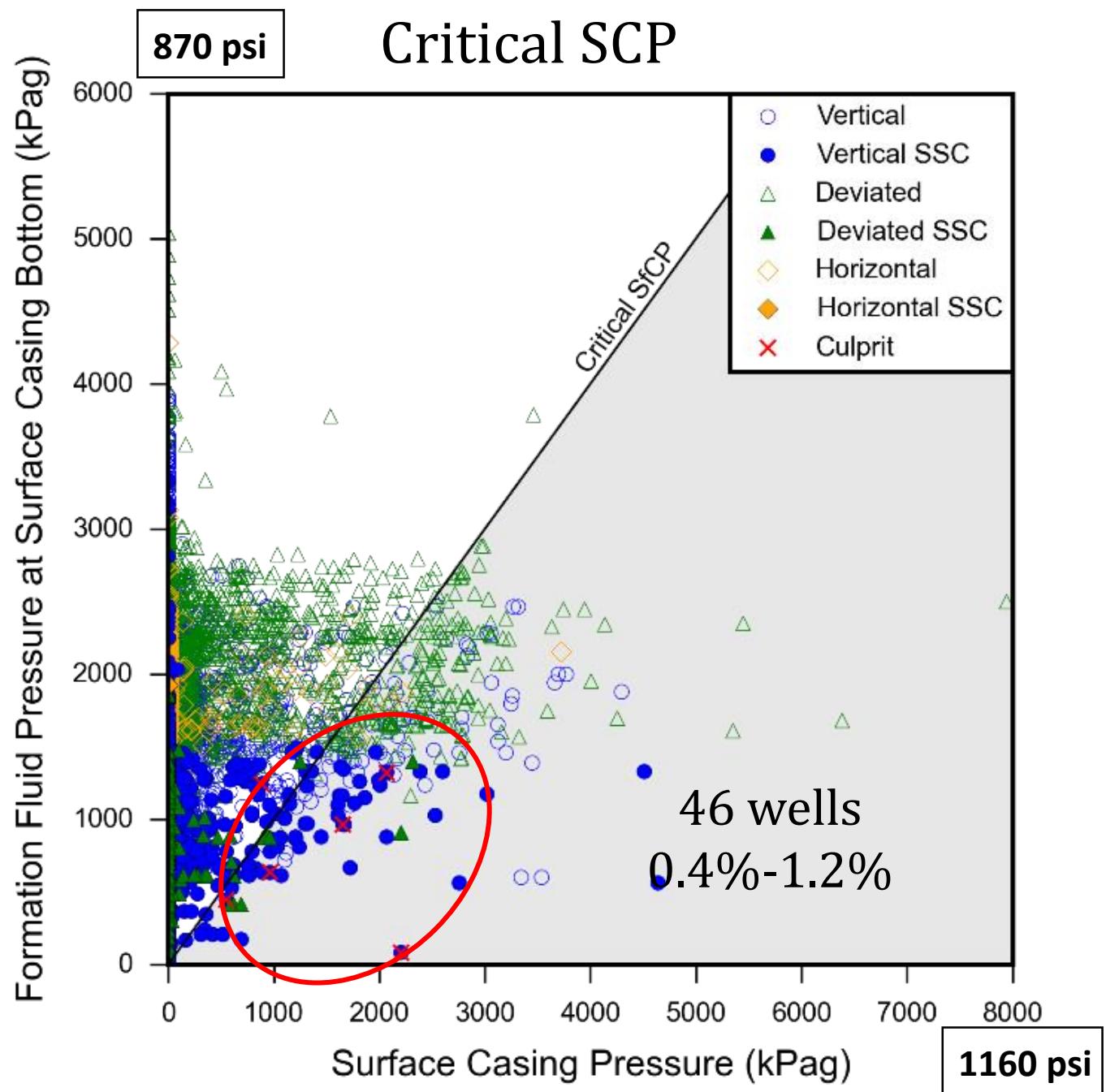
How Many Wells Have SCP?



All Wells (13.8%), Vertical Wells (7.4%), Deviated Wells (21.9%), and Horizontal Wells (18%)



Critical SCP typically increases with surface casing depth

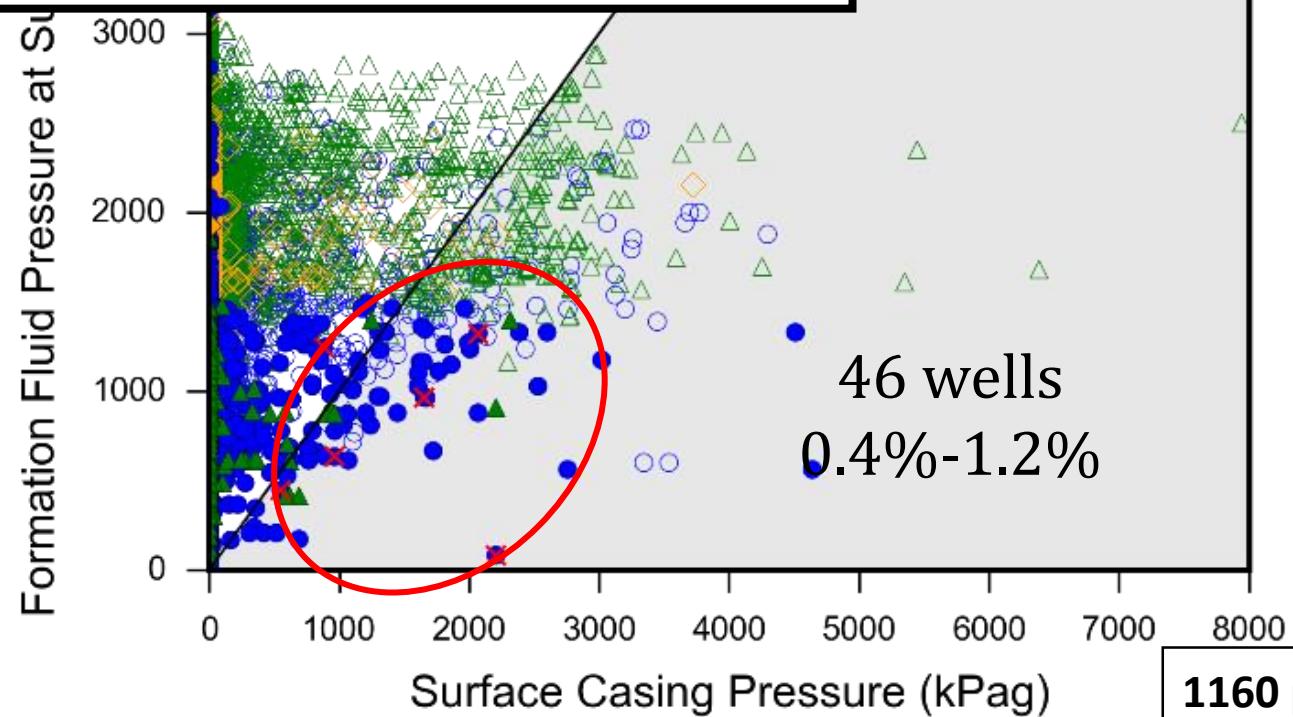


870 psi

Critical SCP

Newer horizontal wells, built with deeper surface casings that exceed current regulations, pose a lower risk for inducing stray gas migration than older vertical wells

- Vertical
- Vertical SSC
- △ Deviated
- ▲ Deviated SSC
- ◊ Horizontal
- ◆ Horizontal SSC
- ✗ Culprit



1160 psi

Critical SCP typically increases with surface casing depth

New Mexico

The screenshot shows the official website for the New Mexico Oil Conservation Division (OCD). The header features the state seal of New Mexico, which includes a sun, a mountain, and an oil derrick. The menu bar at the top includes links for About OCD, Contact OCD, FAQs, Oil Field Education, Brine Well Info, Home, Bureaus, Rules, Forms, OCD Online, OCD GIS, Hearings, Statistics, and Publications. Below the menu is a horizontal banner displaying five images related to oil and gas production: an oil pumpjack, a close-up of a valve or pipe, a large industrial valve, a weathered metal structure, and a pressure gauge. Underneath each image is a circular icon with an 'i' symbol, likely indicating informational content. The main content area contains four sections with links: Announcements & Notifications, Outreach and Training, Hearings, and Oil and Gas Education. Each section has a 'Click Here to Learn More' link.

About OCD Contact OCD FAQs Oil Field Education Brine Well Info

Home Bureaus Rules Forms OCD Online OCD GIS Hearings Statistics Publications

**Announcements
Notifications**
[Click Here to Learn More](#)

**Outreach and
Training**
[Click Here to Learn More](#)

Hearings
[Click Here to Learn More](#)

Oil and Gas Education
[Click Here to Learn More](#)

<http://www.emnrd.state.nm.us/ocd/>

New Mexico



NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OLICENSING DIVISION
ANNUAL REPORTS UNIT
12777 AM 3400
(505) 242-6172 FAX (505) 242-6179
<http://www.sos.state.nm.us/divisions/olicensing/>

BRADENHEAD TEST REPORT

(submit 1 copy to above address)

Date of Test 10-27-11 Operator Conoco Phillips API#30-045-23745

Property Name Blueberry Well No. 345 Location Unit Section 36 Township 32 Range 12

Well Status(Shut-in or Producing) Initial PSI: Tubing 145 Intermediate 144 Casing 148 Bradenhead 135

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		INTERM Int	Csg
	BH Int	Bradenhead Csg		
TIME				
5 min	0	143		
10 min	0	143		
15 min	0	103		
20 min				
25 min				
30 min				

FLOW CHARACTERISTICS

BRADENHEAD INTERMEDIATE

Steady Flow	
Suspect	
Down to Nothing	
Nothing	
Gas	
Gas & Water	
Water	

If bradenhead flowed water, check all of the descriptions that apply below:

CLEAR FOAMY SALTY SWEET BLACK

5 MINUTE SHUT-IN PRESSURE BRADENHEAD 0 INTERMEDIATE 144

REMARKS: Bit to vapor in 60 seconds. - nothing in 15

By L

Witness Maurice Kuehling

ROD JUN 22 11

OLICNSG. DPT.
DIST. 3

(Position)

E-mail address

New Mexico Challenges



NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OL CONSERVATION DIVISION
AZTEC DISTRICT OFFICE
1660 RD BRAZOS ROAD
AZTEC NM 87410
(505) 334-6178 FAX: (505) 334-6179
<http://www.mined.nm.gov/divisions/ol/aztecdistrict.htm>

BRADENHEAD TEST REPORT

(submit 1 copy to above address)

Date of Test 10-27-11 Operator Conoco Phillips API #30-0 45-23745
Property Name Silver Creek Well No. 259 Location Unit Section 36 Township 32 Range 12
Well Status(Shut-In or Producing) Initial PSI: Tubing 145 Intermediate 144 Casing 144 Bradenhead 135

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		INTERM	
	BH	Csg	Int	Csg
TIME				
5 min	0	143		
10 min	0	143		
15 min	0	143		
20 min				
25 min				
30 min.				

FLOW CHARACTERISTICS

	BRADENHEAD	INTERMEDIATE
Steady Flow		
Surge		
Down to Nothing		
Nothing		
Gas		
Gas & Water		
Water		

If bradenhead flowed water, check all of the descriptions that apply below:

CLEAR FRESH SALTY SULFUR BLACK

5 MINUTE SHUT-IN PRESSURE BRADENHEAD 0 INTERMEDIATE 144

REMARKS: bit to water in 40 seconds, - to nothing in 15

By M. Kuehling Witness Marcia Kuehling

ROD JUN 22 '11
OL CMC, DRI,
DIST. 3

(Position) _____

E-mail address: _____



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& NATURAL RESOURCES DEPARTMENT

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AZTEC NM 87410
(505) 334-6178 FAX: (505) 334-6179
<http://www.mined.nm.gov/divisions/ol/aztecdistrict.htm>

OIL CONS. DIV DIST. 3

OCT 08 2015

BRADENHEAD TEST REPORT

(submit 1 copy to above address)

Date of Test 10-8-15 Operator BP America API #30-0 45-20006
Property Name Gas disposal Well No. 259 Location: Unit P Section 14 Township 28 Range 12
Well Status(Shut-In or Producing) Initial PSI: Tubing 160 Intermediate 144 Casing 0 Bradenhead 0

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		FLOW CHARACTERISTICS	
	BH	Brad	Brad	Inter
TIME	BH	Brad	Csg	Csg
5 min	0	0		
10 min	0	0		
15 min	0	0		
20 min				
25 min				
30 min				

FLOW CHARACTERISTICS

BRADENHEAD INTERMEDIATE

Steady Flow	
Surges	
Down to Nothing	
Nothing	
Gas	
Gas & Water	
Water	

If bradenhead flowed water, check all of the descriptions that apply below:

CLEAR FRESH SALTY SULFUR BLACK

5 MINUTE SHUT-IN PRESSURE BRADENHEAD 0 INTERMEDIATE 144

REMARKS: Nothing when opened.
Nothing when opened after 5 min shutin

By Dubert Diaz /BP

Witness Marcia Kuehling

(Position) _____

E-mail address: _____

2.25 million documents labeled only by API# and all are scanned images (~600,000 of interest)

New Mexico Challenges



NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OL CONSERVATION DIVISION
Aztec District Office
1660 RD BRAZOS ROAD
AZTEC NM 87010
(505) 334-6178 FAX: (505) 334-6179
<http://www.mined.nm.gov/olconserv/division.html>

BRADENHEAD TEST REPORT
(submit 1 copy to above address)

Date of Test 10-27-11 Operator Croncat Well Inc. API #30-0 45-23745
 Property Name Silver Creek Well No. 259 Location Unit Section 36 Township 32 Range 12
 Well Status(Shut-In or Producing) Initial PSI: Tubing 445 Intermediate 444 Casing 444 Bradenhead 135

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		FLOW CHARACTERISTICS	
	Bradenhead	Interm	Bradenhead	Intermediate
TIME	BH	Int	Csg	Csg
5 min	0	143		
10 min	0	143		
15 min	0	103		
20 min				
25 min				
30 min				

If bradenhead flowed water, check all of the descriptions that apply to

CLEAR FRESH SALTY SALT FLUR

5 MINUTE SHUT-IN PRESSURE BRADENHEAD 0

REMARKS: bit to water in 40 seconds. -0 nothing in 15

By Monica Kuehling Witness Monica Kuehling
 (Position) Oil Cons. Div. 13P (Position) Oil Cons. Div. 13P
 E-mail address Monica.Kuehling@nmr.state.nm.us

ROD JUN 22 '11
OL CONS. DIV.
DIST. 3

How do you sort through
hundreds of thousands of image
based documents in a reasonable
manner?

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OL CONSERVATION DIVISION
AZTEC DISTRICT OFFICE
1660 RD BRAZOS ROAD
AZTEC NM 87010
(505) 334-6178 FAX: (505) 334-6179
<http://www.mined.nm.gov/olconserv/division.html>

OIL CONS. DIV DIST. 3
OCT 08 2015

BRADENHEAD TEST REPORT
(submit 1 copy to above address)

Date of Test 10-8-15 Operator BP America API #30-0 45-20006
 Property Name Gas disposal Well No. 259 Location: Unit P Section 14 Township 28 Range 12
 Well Status(Shut-In or Producing) Initial PSI: Tubing 160 Intermediate 444 Casing 0 Bradenhead 0

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		FLOW CHARACTERISTICS	
	BH	Brad	Brad	Interm
TIME	Int	Csg	Int	Csg
5 min	0	0		

Steady Flow _____
 No Nothing _____
 Water _____
 Gas below _____
 IR BLACK _____
 INTERMEDIATE 444

Nothing when opened.
 Nothing when opened after 5 min shut-in

By Dubert Diaz 13P Witness Monica Kuehling
 (Position) Oil Cons. Div. 13P (Position) Oil Cons. Div. 13P
 E-mail address Monica.Kuehling@nmr.state.nm.us

2.25 million documents labeled only by API# and all are scanned images (~600,000 of interest)

TensorFlow



Open source machine learning framework developed by Google

TensorFlow



Open source machine learning framework developed by Google

Can be used for broad range of machine learning tasks but was developed for
deep neural network modeling

TensorFlow



Open source machine learning framework developed by Google

Can be used for broad range of machine learning tasks but was developed for
deep neural network modeling

Commonly used for categorization tasks

Roughly How it Works

“MobileNet” convolutional neural network

<https://arxiv.org/pdf/1704.04861.pdf>

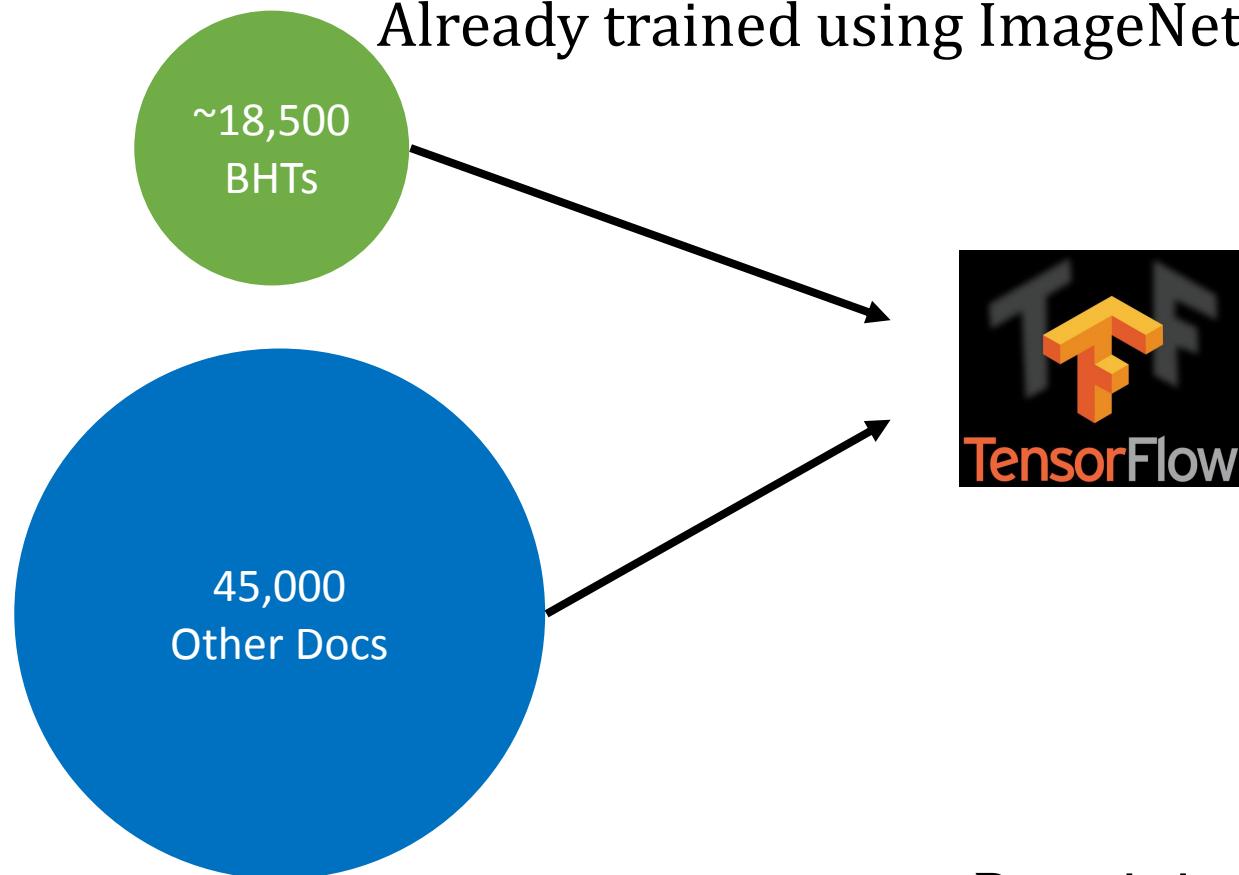
Already trained using ImageNet (>14 million images)

Roughly How it Works

“MobileNet” convolutional neural network

<https://arxiv.org/pdf/1704.04861.pdf>

Already trained using ImageNet (>14 million images)



Retraining

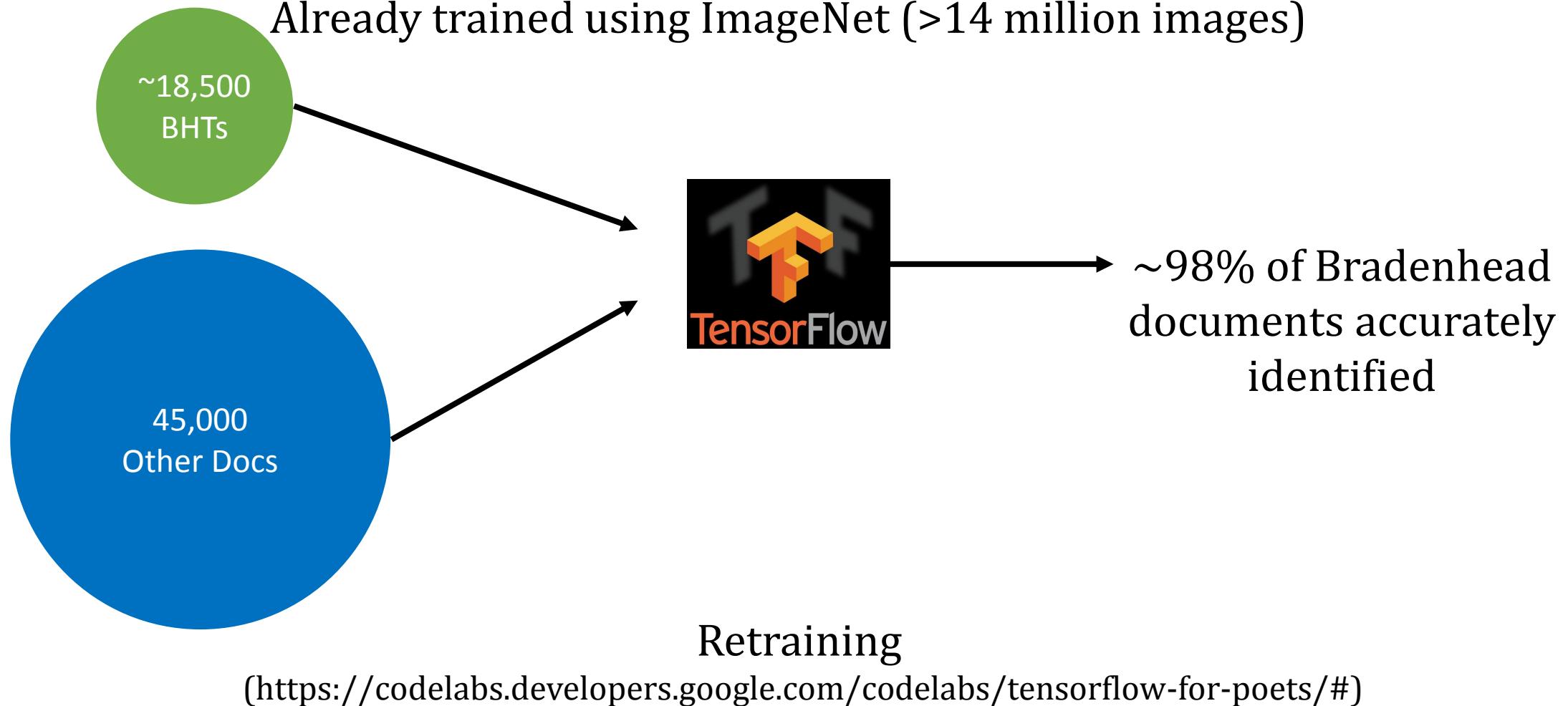
(<https://codelabs.developers.google.com/codelabs/tensorflow-for-poets/#>)

Roughly How it Works

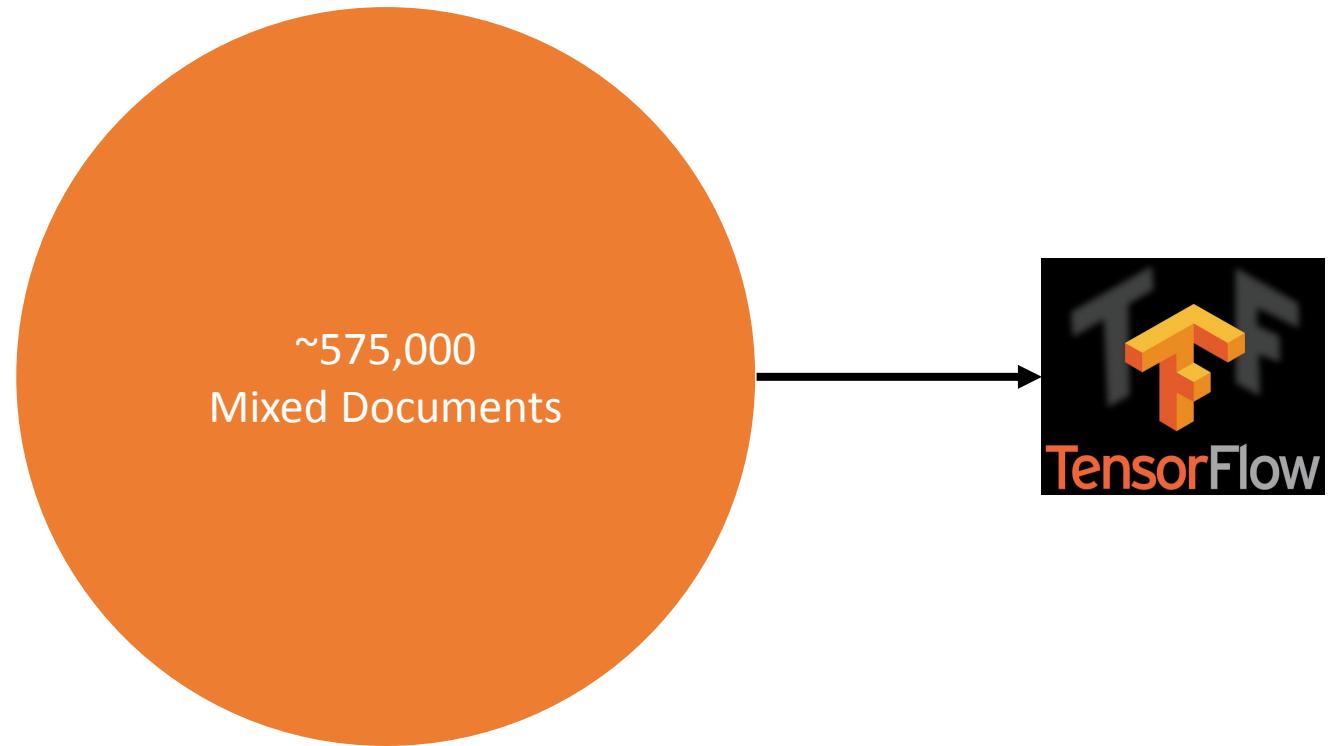
“MobileNet” convolutional neural network

<https://arxiv.org/pdf/1704.04861.pdf>

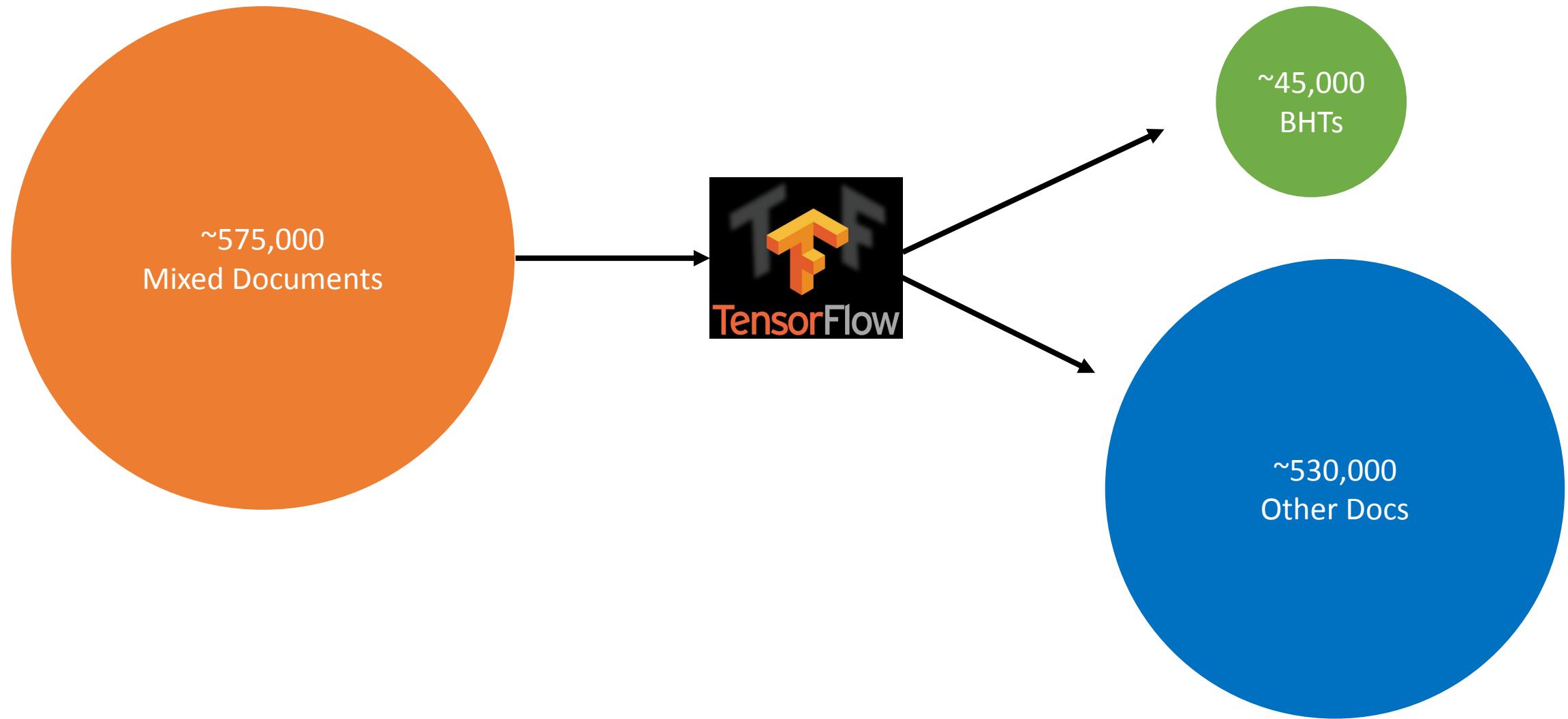
Already trained using ImageNet (>14 million images)



Document Sorting



Document Sorting



New Mexico Challenges



NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OL CONSERVATION DIVISION
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1660 RD BRAZOS ROAD
AZTEC NM 87410
(505) 334-6178 FAX: (505) 334-6179
<http://nmenergy.state.nm.us/divisions/minerals/resources/oil/>

BRADENHEAD TEST REPORT
(submit 1 copy to above address)

Date of Test 10-27-11 Operator Croncat Well Inc. API #30-0 45-23745
 Property Name Solar Comps Well No. 259 Location Unit Section 36 Township 32 Range 12
 Well Status(Shut-In or Producing) Initial PSI: Tubing 445 Intermediate 444 Casing 444 Bradenhead 135

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		INTERM		INTERM
	BH	Int	Csg	Int	Csg
TIME					
5 min	0	143			
10 min	0	143			
15 min	0	103			
20 min					
25 min					
30 min					

If bradenhead flowed water, check all of the descriptions that apply to

CLEAR FRESH SALTY SALT FLIR

5 MINUTE SHUT-IN PRESSURE BRADENHEAD 0

REMARKS: bit to water in 40 seconds. -0 nothing in 15

By M. Kuehling Witness Marcia Kuehling

ROD JUN 22 '11

OIL CONS. DIV.
DIST. 3

(Position)

E-mail address: _____

How do you get data from
thousands of images that change
format and are often scanned
poorly?

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& NATURAL RESOURCES DEPARTMENT

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<http://nmenergy.state.nm.us/divisions/minerals/resources/oil/>

OIL CONS. DIV DIST. 3
OCT 08 2015

BRADENHEAD TEST REPORT
(submit 1 copy to above address)

Date of Test 10-8-15 Operator BP America API #30-0 45-20006
 Property Name Gas disposal Well No. 259 Location: Unit P Section 14 Township 28 Range 12
 Well Status(Shut-In or Producing) Initial PSI: Tubing 160 Intermediate 144 Casing 0 Bradenhead 0

OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH

Testing	PRESSURE		FLOW CHARACTERISTICS	
	BH	Int	Bradenhead	Intermed
TIME	BH	Int	Csg	Csg
5 min	0	0		

Steady Flow _____
 Surge _____
 Down to No _____
 Nothing _____
 Gas _____
 Gas & Water _____
 Water _____

BRADENHEAD INTERMEDIATE

INTERMEDIATE 144

INTERMEDIATE 144

Nothing when opened.
 Nothing when opened after 5 min shut-in

By Dubert Diaz / SP Witness Marcia Kuehling

(Position) _____

E-mail address: _____

2.25 million documents labeled only by API# and all are scanned images
 (~600,000 of interest)

Web Application



Web Application

Visual Scraper

Home

Login

Please log in to access this page.

Sign In

Username

Password

Remember Me

Sign In

scraper.airwatergas.org

Web Application

Visual Scraper Home

Profile Logout Scraper

Hi, greg!

You have scraped 221 documents.

A total of 6191 documents have been scraped thus far.

There are 39210 documents left to be scraped.

Begin Scraping

Score Board



valerie_c: 173



steven_w: 108



marcus_K: 44



benjamin_w: 60



devansh: 713

Web Application

Visual Scraper Home

[Profile](#) [Logout](#) [Scraper](#)

3004534135_9_wf.jpg Successfully Submitted!

	NEW MEXICO ENERGY, MINERALS & NATURAL RESOURCES DEPARTMENT		OFFICE OF ENERGY REGULATORY ADMINISTRATION 200 EAST 3RD STREET SUITE 1000 AUSTIN, TEXAS 78701 http://www.oer.state.tx.us REG. NO. 00000000000000000000000000000000	
BRADENHEAD TEST REPORT				
(submit 1 copy to above address)				
Date of Test	10-27-11	Operator	Conoco Phillips API#30-045-73745	
Property Name	Silver Canyon	Well No.	524	Location: Unit Section 36 Township 32 Range 17
Well Status(Shut-in or Producing)	Producing	Initial PSI:	Tubing 45	Intermediate 48 Casing 148 Bradenhead 133
OPEN BRADENHEAD AND INTERMEDIATE TO ATMOSPHERE INDIVIDUALLY FOR 15 MINUTES EACH				
PRESSURE			FLOW CHARACTERISTICS	
Testing	Bradenhead	Intermed	Bradenhead	Intermediate
TIME	BH	Inlet Casing	Int	Casing
5 min	0	143		
10 min	0	143		
15 min	0	143		
20 min				
25 min				
30 min				
If bradenhead flowed water, check all of the descriptions that apply below:				
CLEAR <input type="checkbox"/> FISHY <input type="checkbox"/> SALTY <input type="checkbox"/> SULFURIC <input type="checkbox"/> BLACK <input type="checkbox"/>				
5 MINUTE SOAK-IN PRESSURE		BRADENHEAD	0	INTERMEDIATE
REMARKS: <i>flow to surface in 10 seconds, -0 nothing in 15</i>				
<i>R. L.</i>		<i>Wm. Morris Kuhling</i>		
(Signature)		RCVD JUN 22 2011 OIL/GAS DIV. DIST. 3		
E-mail address: _____				

Entry Data

[Go Back](#)

Test Date (e.g. YYYY-MM-DD)

2011-06-28

Initial Bradenhead Pressure

Initial Intermediate 1 Pressure

ANSWER

1

Initial Tubing Pressure

Final Bradenhead Pressure

ANSWER

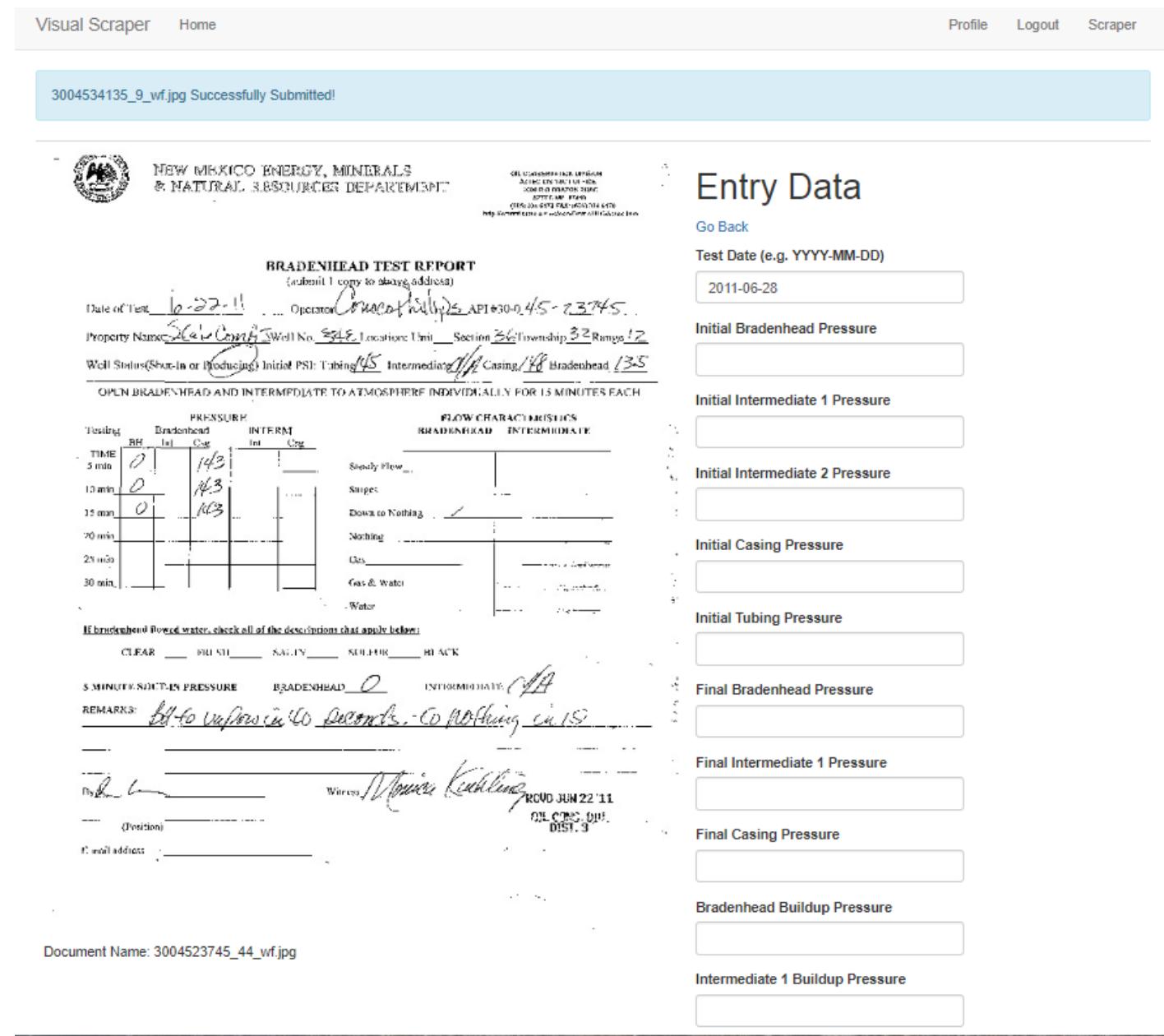
Final Intermediate 11

ANSWER

Bradenhead Buildup Press

Document Name: 3004523745_44_wf.jpg

Web Application



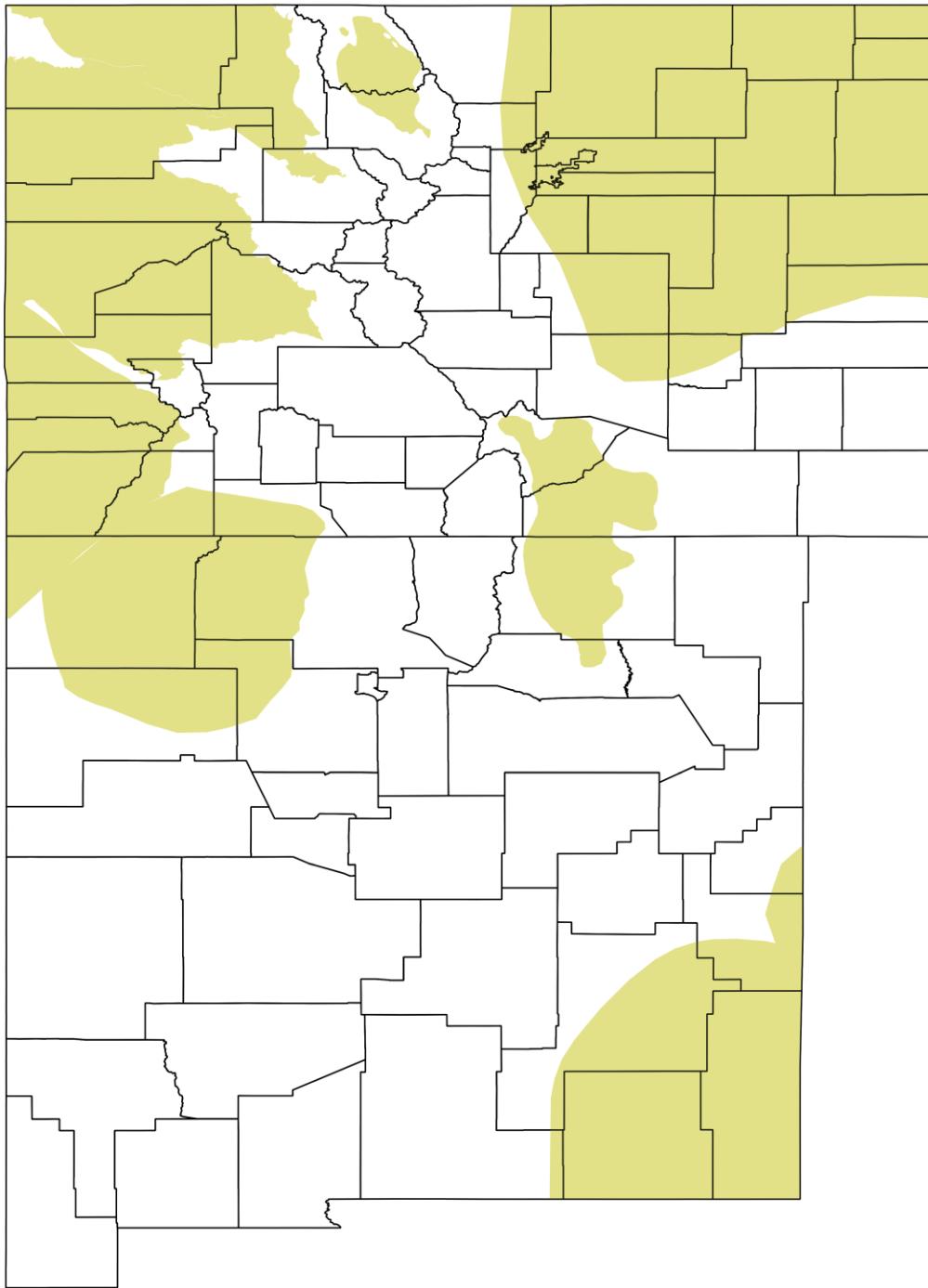
Website accessible from anywhere

Multiple scrapers can work
at the same time

~15 seconds a document

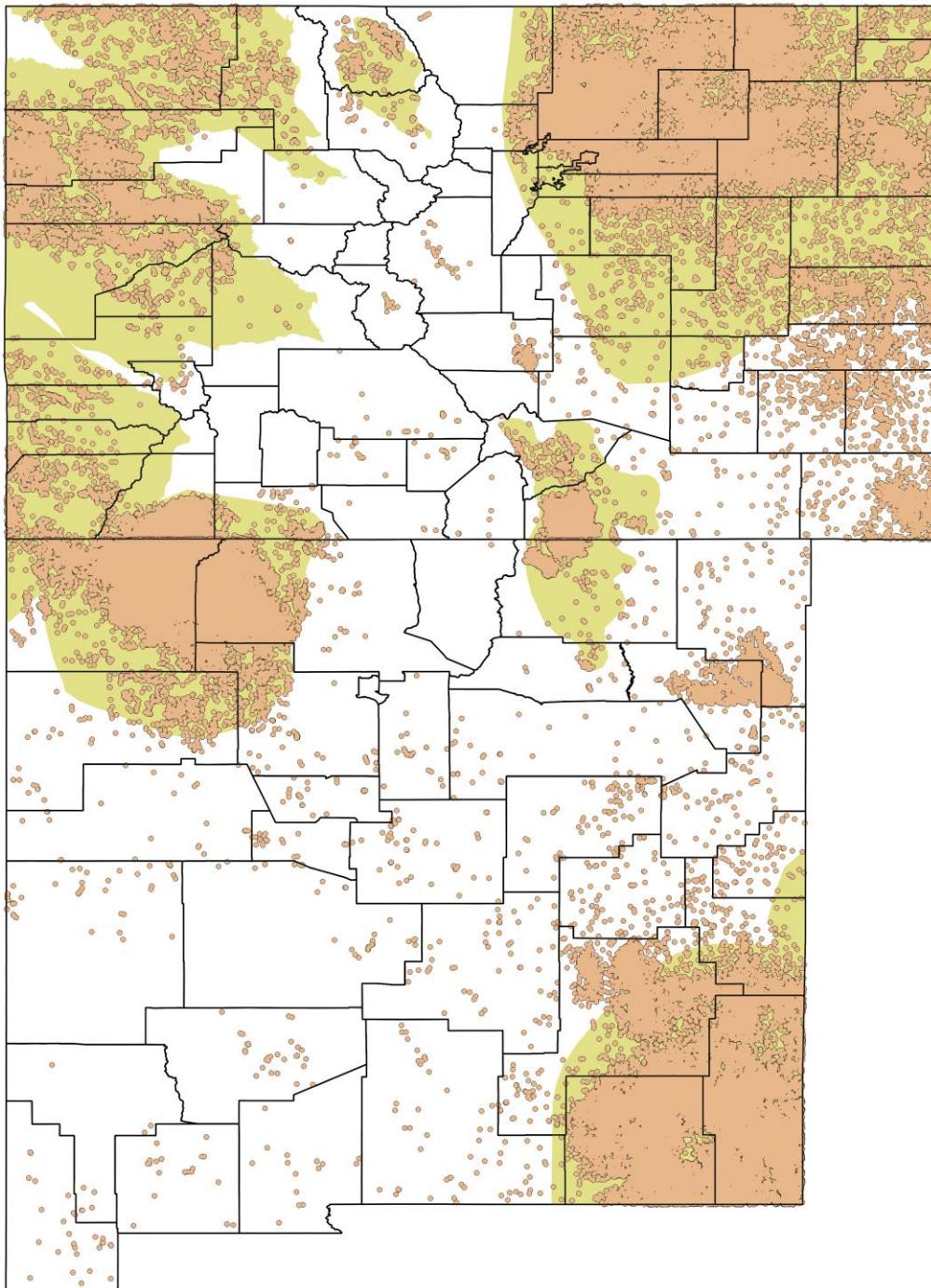
190 hours of work

Preliminary Data

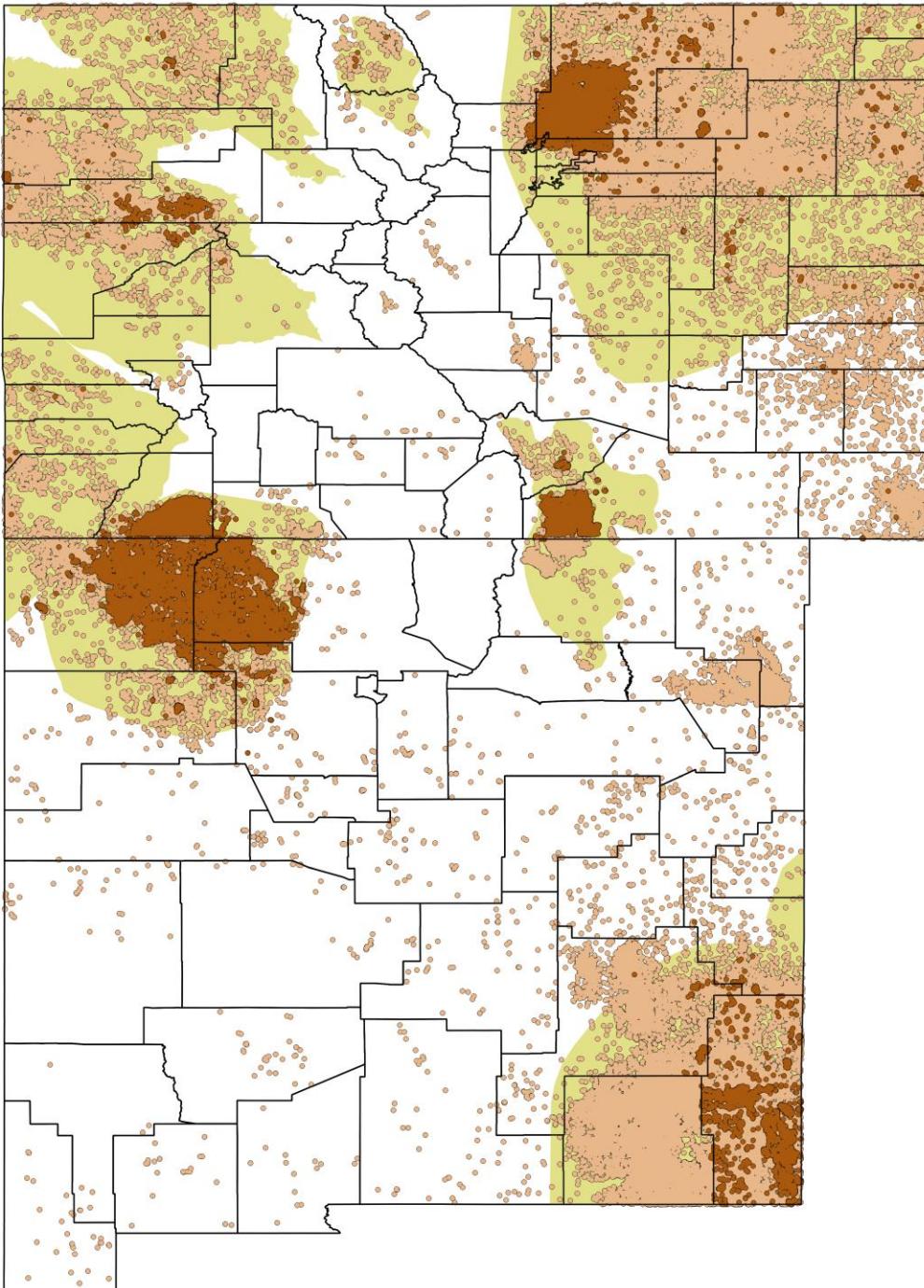


Preliminary Data

Well construction records for 232,645 wells in Colorado (114,843) and New Mexico (117,802).



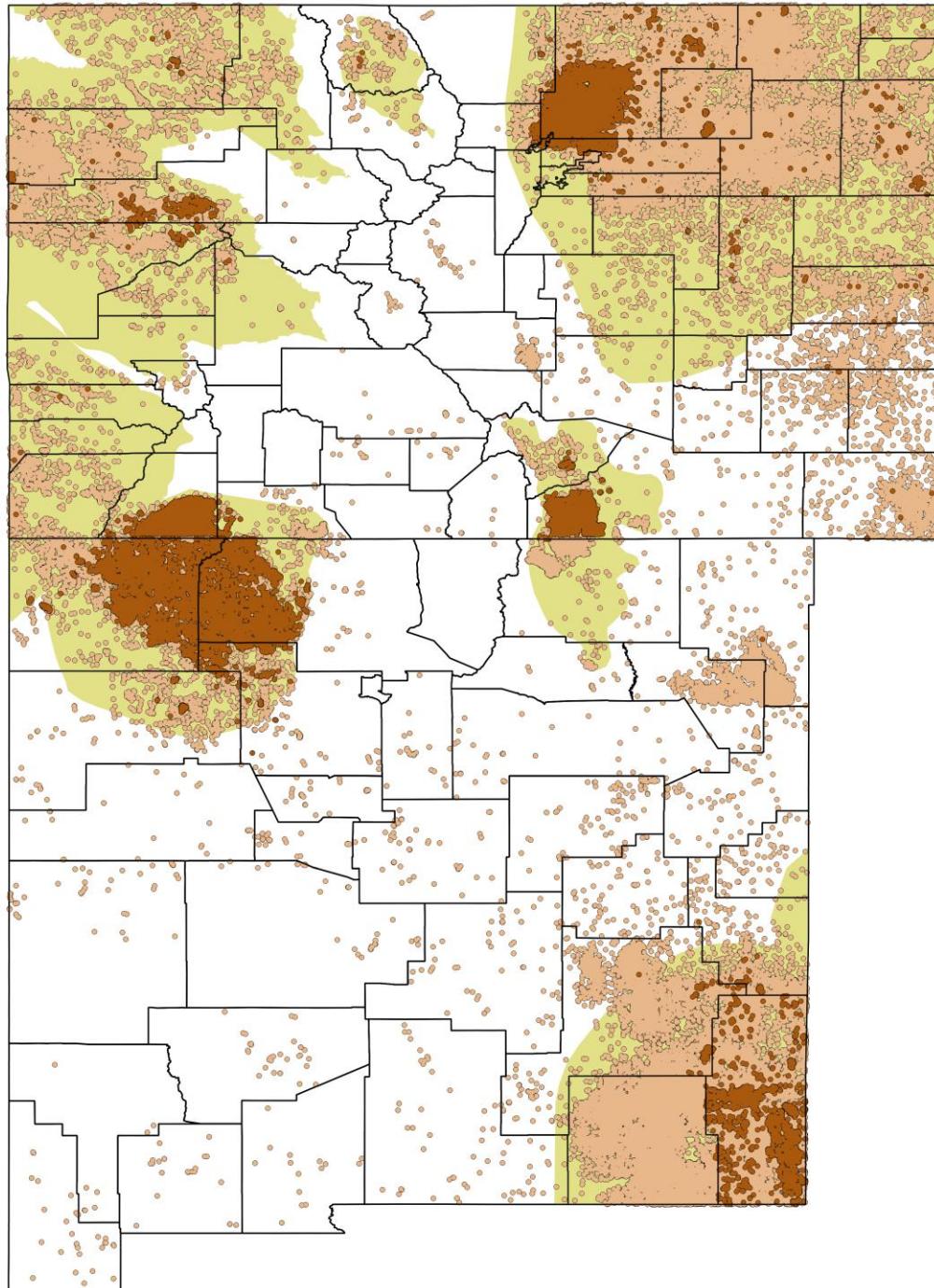
Preliminary Data



Well construction records for 232,645 wells in Colorado (114,843) and New Mexico (117,802).

Well integrity test records for 34,727 wells. 19,540 in Colorado and 15,187 in New Mexico.

Preliminary Data



Well construction records for 232,645 wells in Colorado (114,843) and New Mexico (117,802).

Well integrity test records for 34,727 wells. 19,540 in Colorado and 15,187 in New Mexico.

After release of PA DEP well integrity data this will be the second largest dataset of well integrity information in the United States.

Conclusions

- Sustained casing pressure is an easily measure, but poorly documented, gauge of oil and gas well integrity.
- Bradenhead testing in Colorado and New Mexico provides insight into the development of SCP in oil and gas wells and can be used to identify wells that pose a high risk of inducing stray gas migration.
- Image based documents of interest can be identified and sorted from databases that contain seemingly unmanageable numbers of files using TensorFlow.
- Data from these documents can be easily obtained using a simple document scraping web application.

Acknowledgements

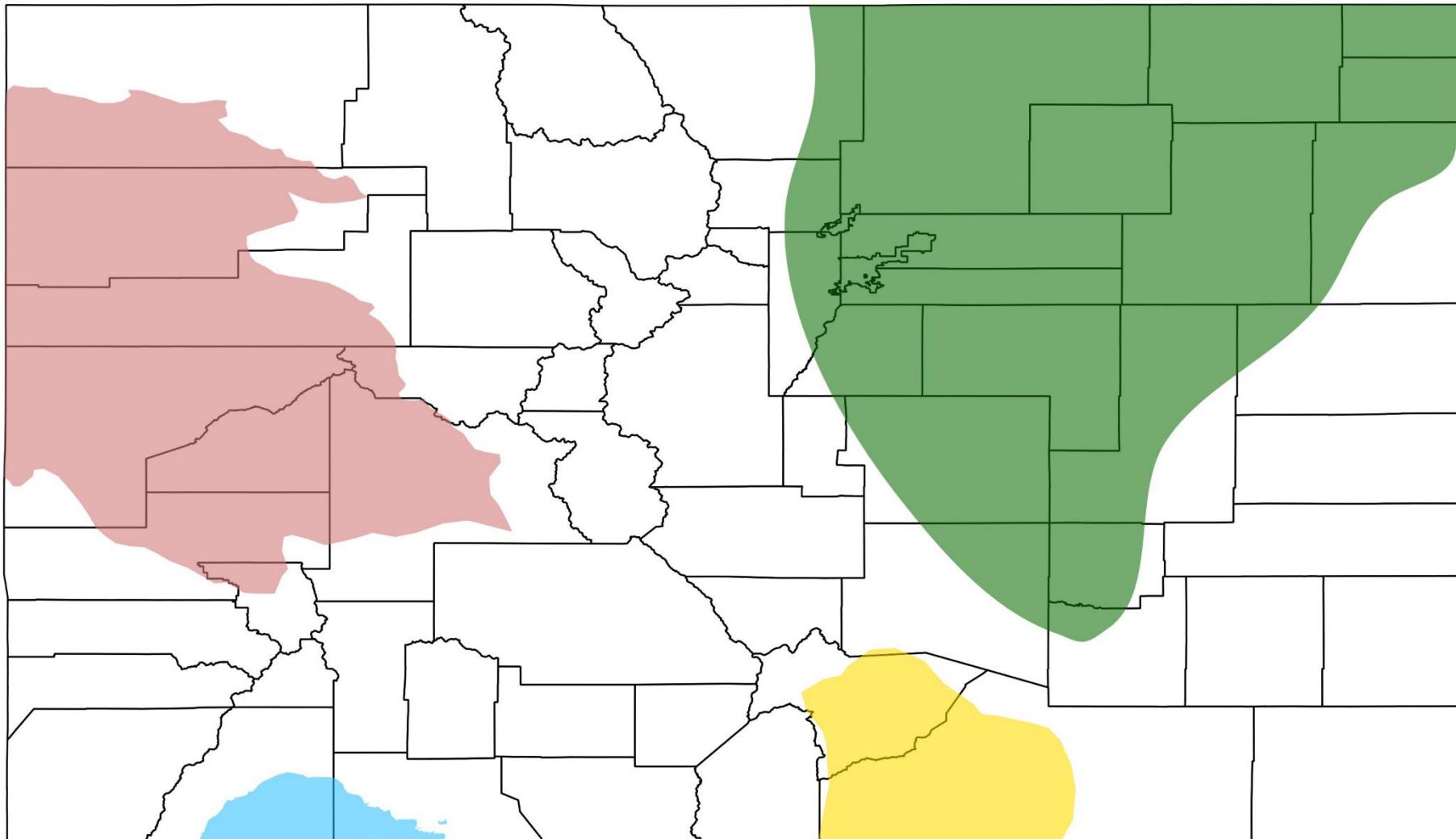
- National Science Foundation Sustainability Research Network Program (Grant CBET-1240584).



- Harihar Rajaram, Owen Sherwood, Joe Ryan, Troy Burke, Devansh Chauhan
- Summer scrapers: Natalie Guinan, Steven Wilder, Lewis Schiebel, Marcus Knipp, Valerie Constien, Benjamin Willows, Ludvig Zwilgmeyer

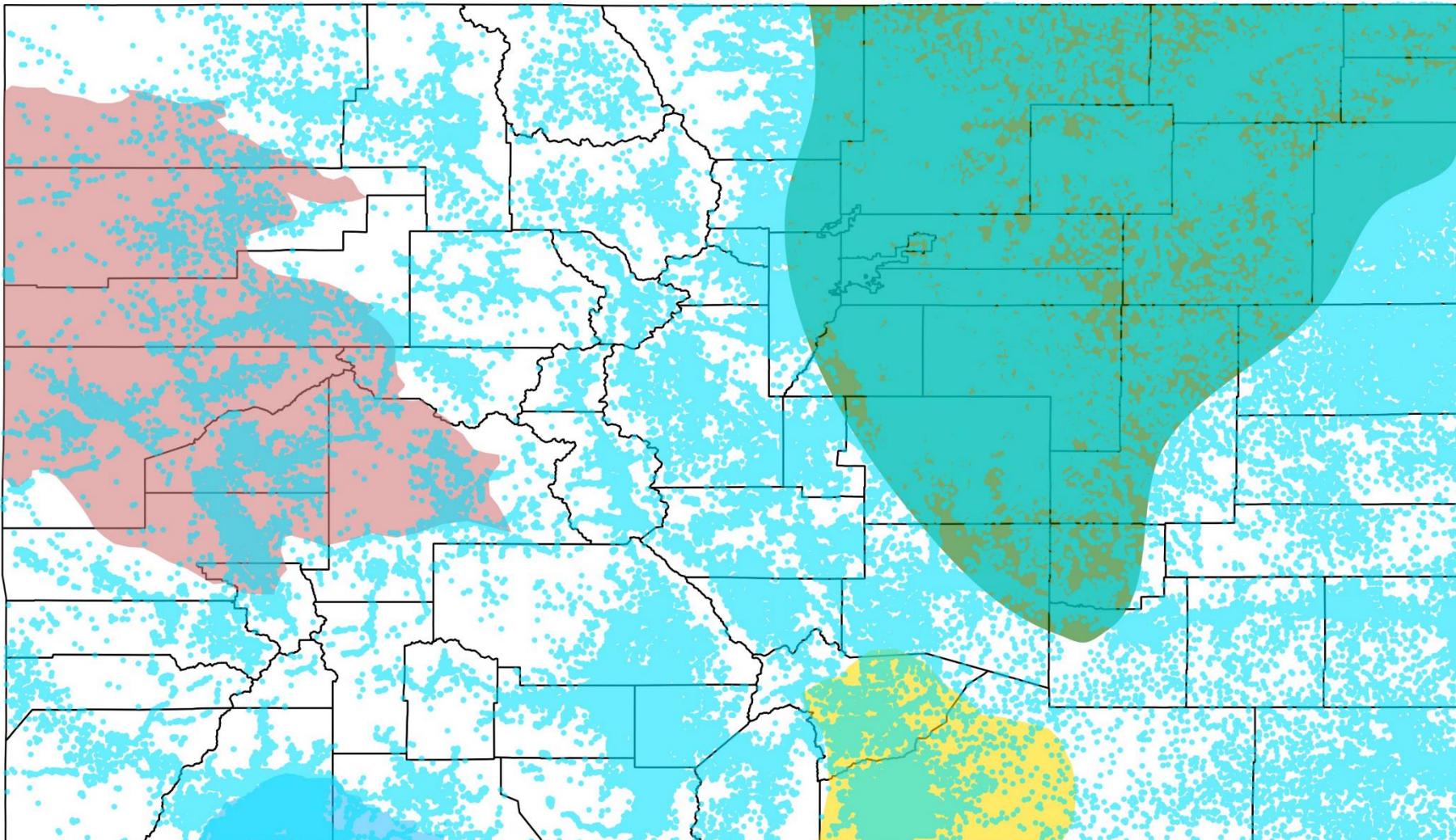
Extra Slides

Drilling in Colorado



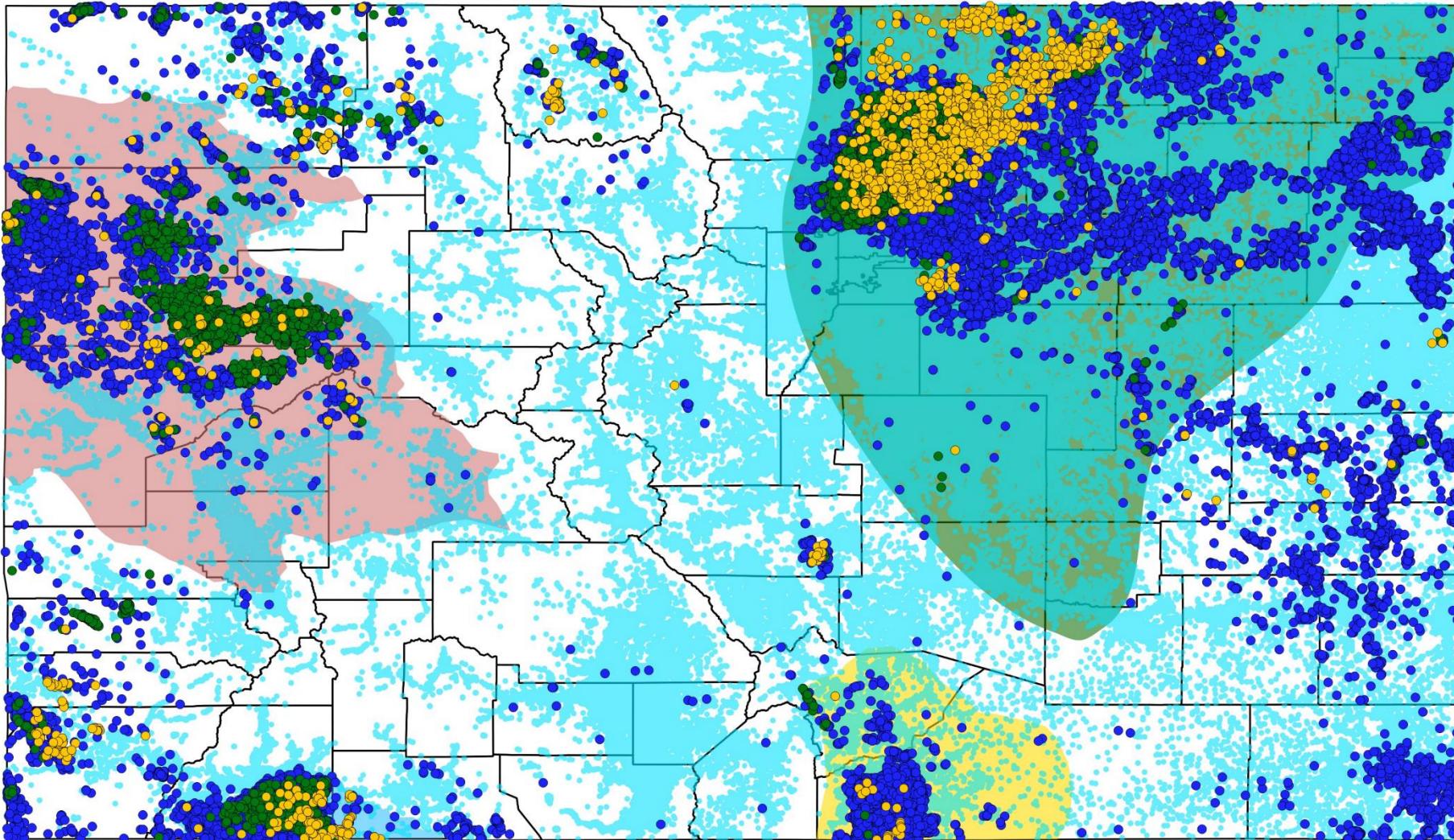
Four major oil and gas basins: DJ, Piceance, San Juan, and Raton

Drilling in Colorado



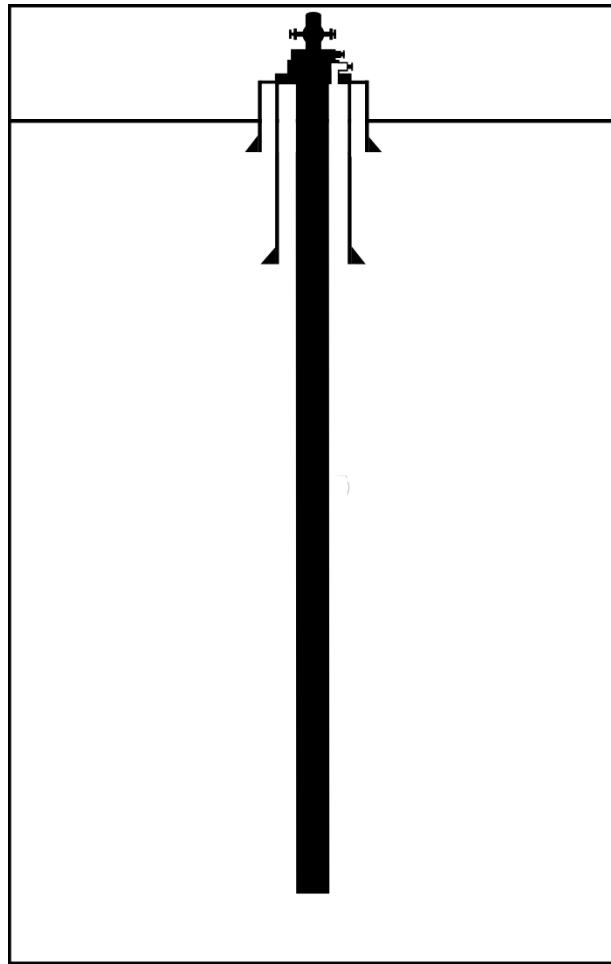
> 300,000 Water wells

Drilling in Colorado

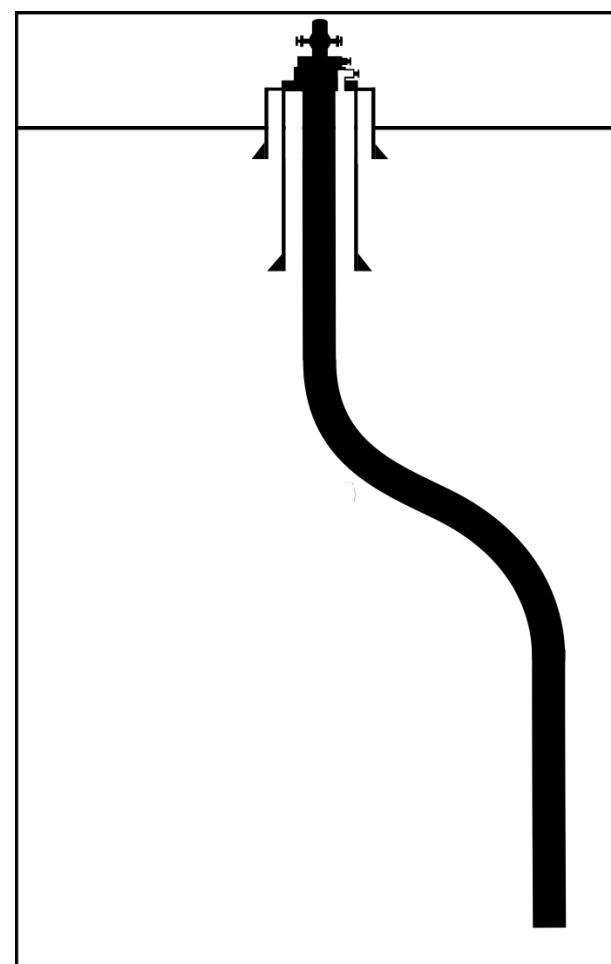


Total: 64,289; Vert: 42,279; Dev: 18,761; Horiz: 3,249

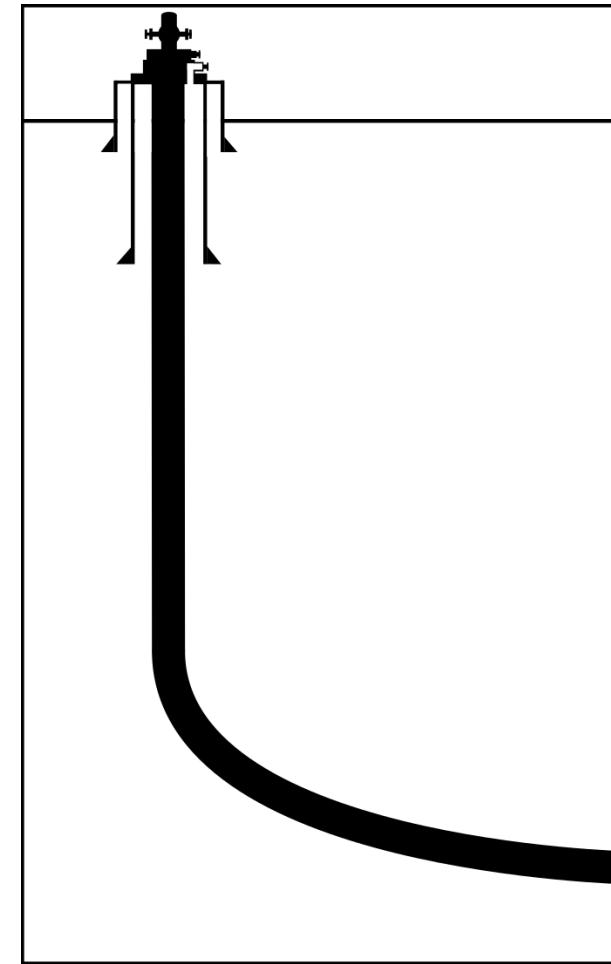
Well Configurations



Vertical

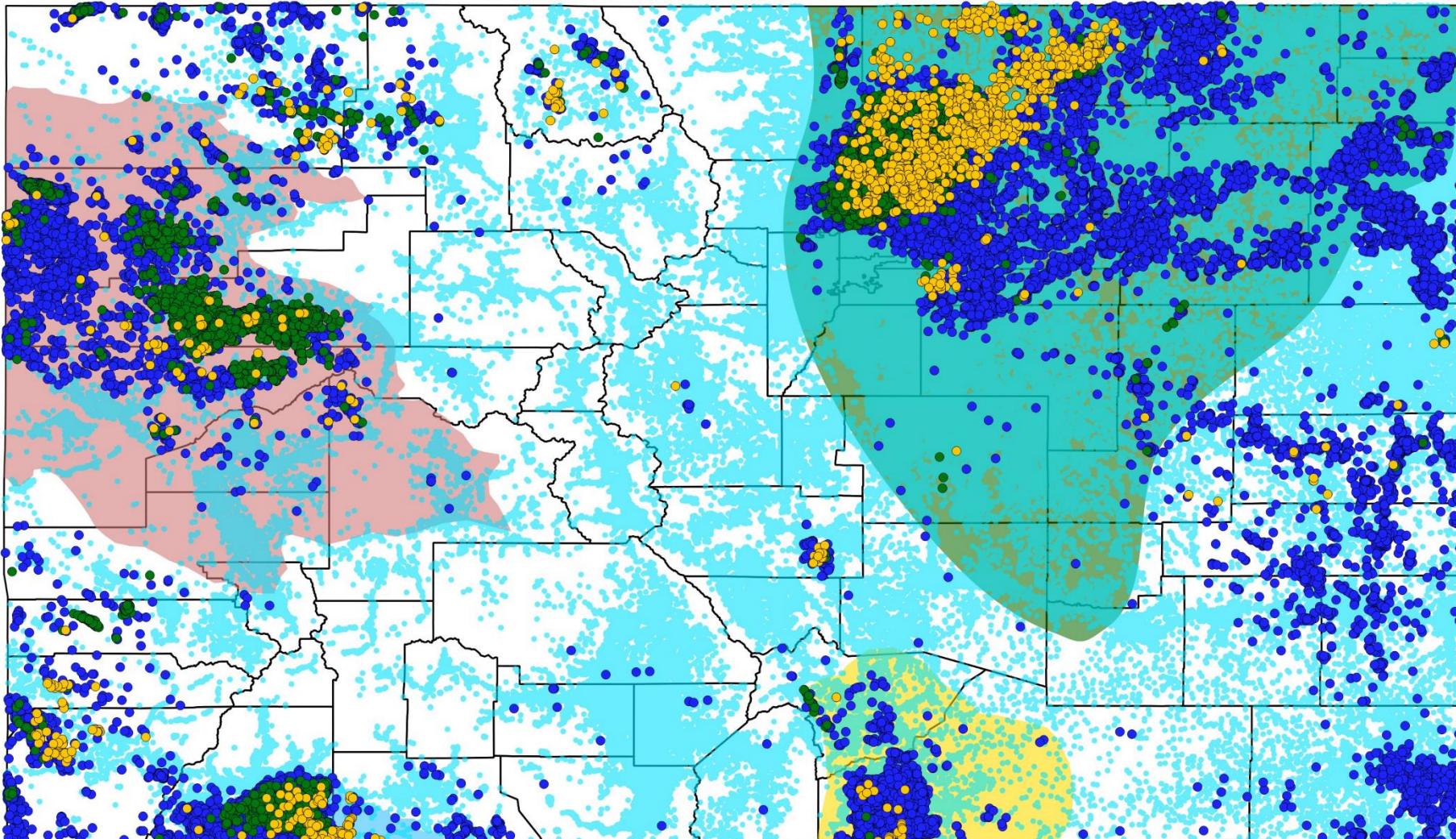


Deviated/Directional



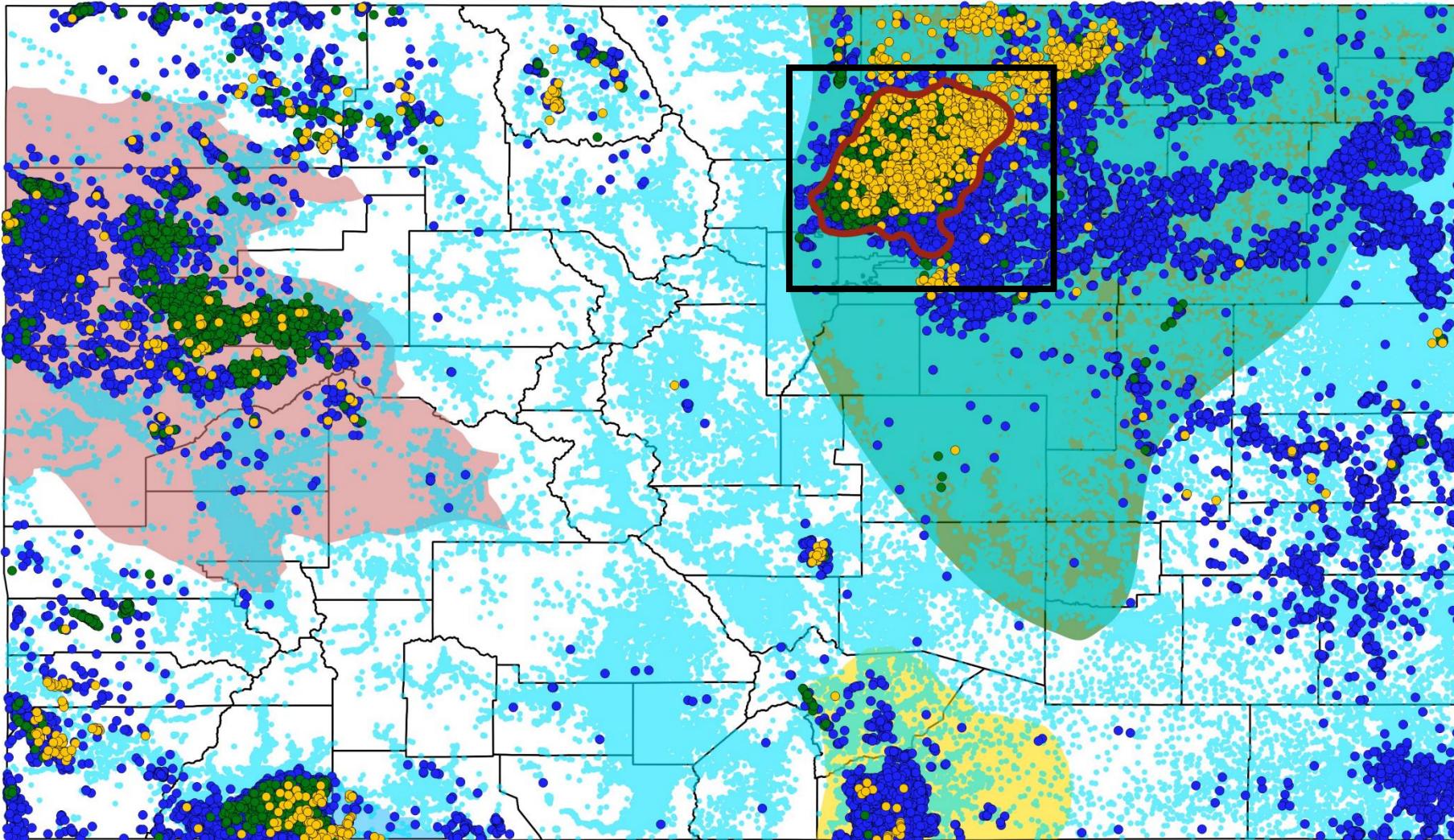
Horizontal

Drilling in Colorado



Total: 64,289; Vert: 42,279; Dev: 18,761; Horiz: 3,249

Drilling in Colorado



Total: 64,289; Vert: 42,279; Dev: 18,761; Horiz: 3,249

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application