



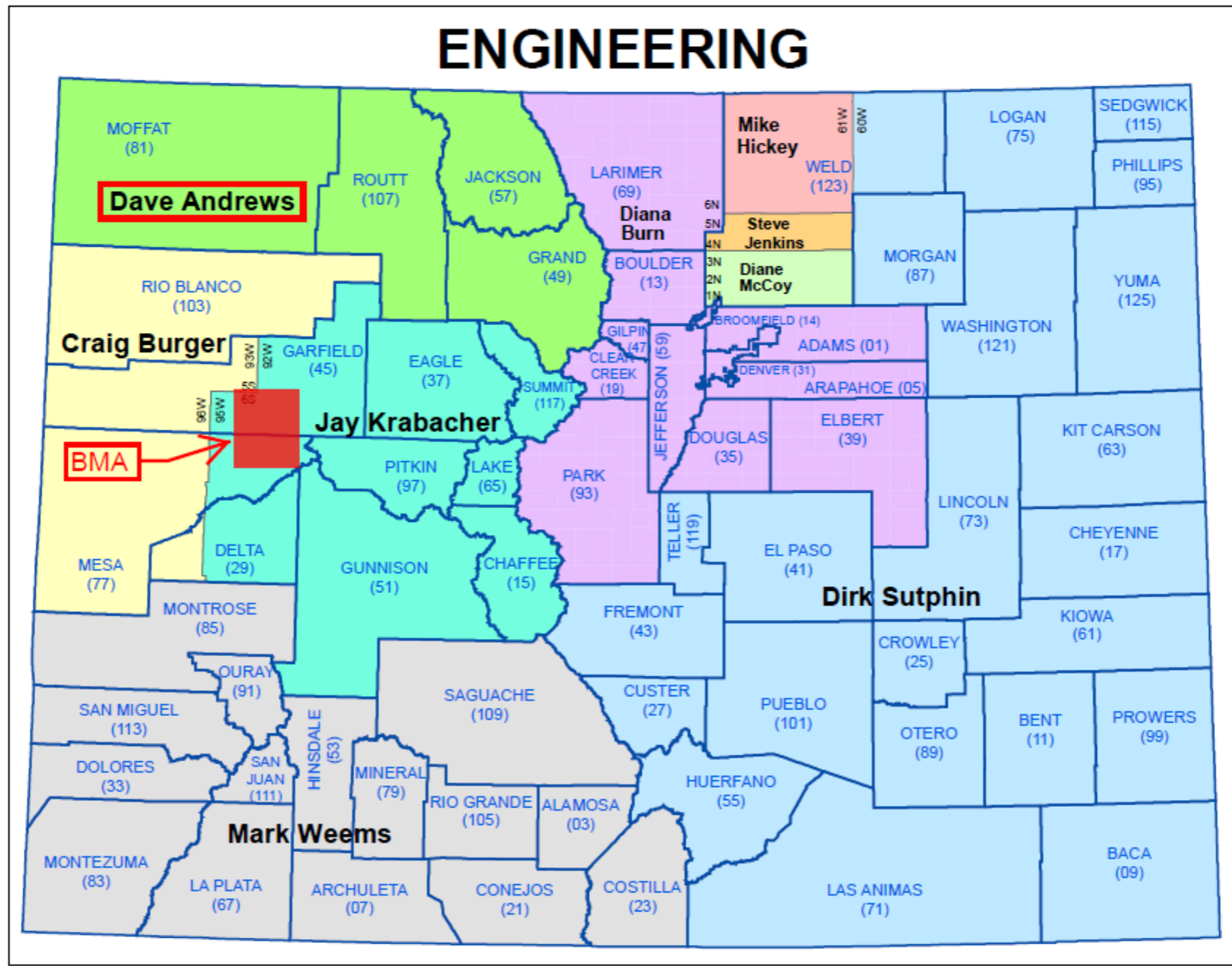
*Report Summary: Casing and Cement
Standards for Geologic Isolation
Piceance Basin Bradenhead Monitoring Area
and Nearby Fields*



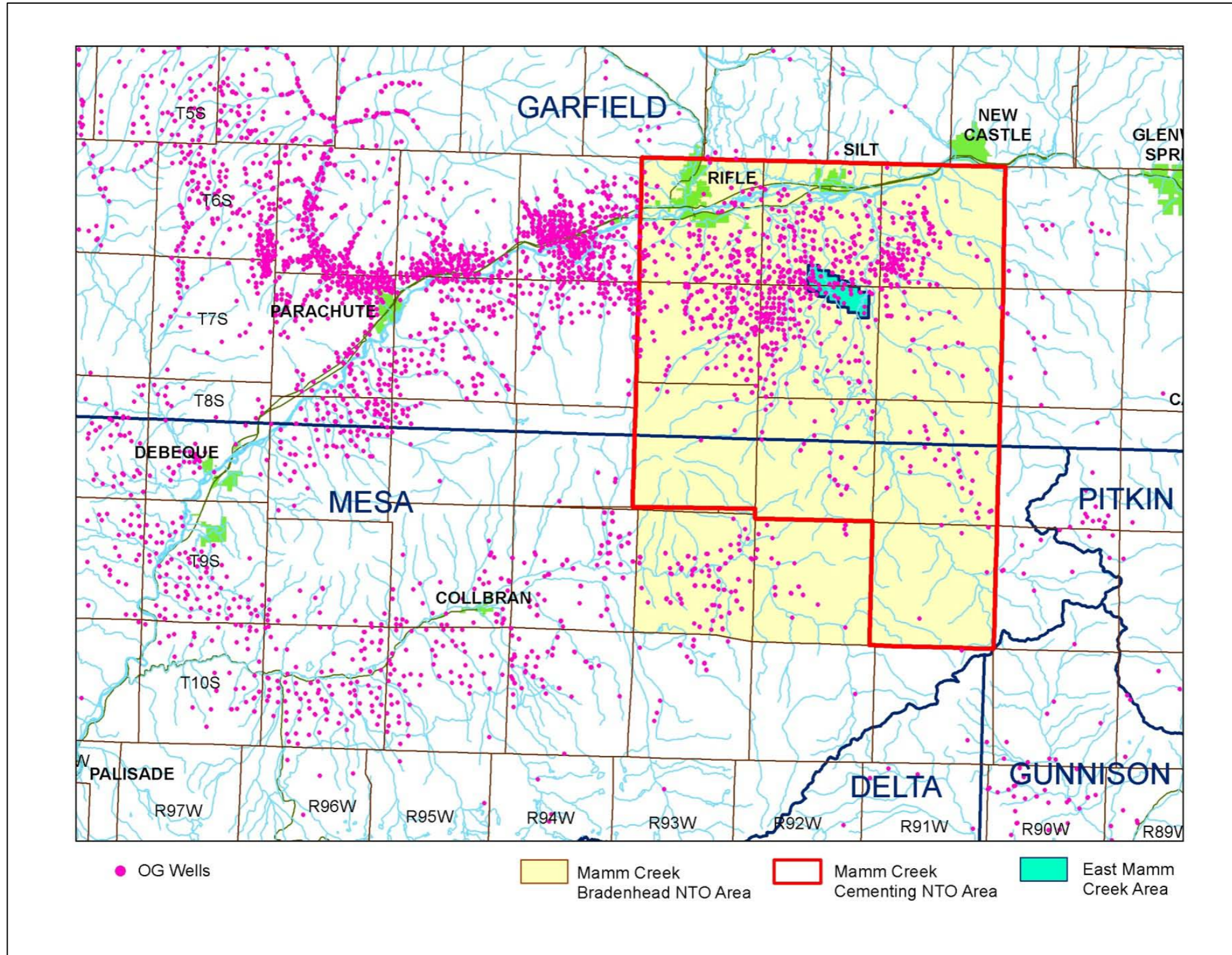
COLORADO
Department of Natural Resources

COGCC Commission Hearing, Denver, Colorado
April 18, 2016
David Andrews, Engineering Supervisor

About the Author



Cementing and Bradenhead NTO Areas



Summary

COGCC Staff has prepared a report for the Piceance Basin Bradenhead Monitoring Area (BMA) and Nearby Fields to Standardize Geologic Isolation Requirements

COGCC rules require isolation of hydrocarbon and fresh water formations to prevent migration of fluids between formations

Operator-reported formation tops for Upper Cretaceous and Tertiary Formations have been inconsistent in the BMA from field to field; this report uses a consensus of operator data for consistency with the new standards

The report is being released today with this presentation to the Commission

Casing and Cement Standard History

Casing and Cement Standards have changed from time to time in the BMA and Nearby Fields in response to incidents, complaint investigations, and interagency cooperation

- 1997 Drilling Permit Conditions of Approval and Rulison Overpressured Area
- 1998-2006 Garfield County Notice to Operators (NTO)
- 2004-2006 Mamm Creek Area Field Orders (some orders included many other nearby fields)
- 2004, 2007, and 2010 Cementing and Bradenhead Monitoring NTOs
- 2009 and 2011 Update presentations to the Commission
- 2011, 2012, 2015, and 2016 Inter-agency meetings with BLM and EPA

West Divide Creek Gas Seep Summary

January 2004, Gas kicks were encountered in the Wasatch Formation (uncommon) and the Williams Fork Formation (more common) while drilling the Schwartz 2-15B (O2) Well (Mamm Creek Field)

February 2004, Production casing cement top fell from surface to 4,328 feet after cementing (COGCC was not notified until after stimulation commenced in March 2004)

February and March 2004, pressure buildup on the shut-in bradenhead annulus following the production casing cement job

March 2004, operator proceeded with hydraulic fracture stimulation, and notified COGCC of high bradenhead pressure

April 2004, Complaint received by COGCC, regarding a gas seep in West Divide Creek near the gas well; operator remediated the well and commenced investigation of the seep

Cementing NTO Summary

The Cementing NTO was published in 2004 after the West Divide Creek Seep, and a drilling moratorium was implemented within a 2-mile radius of the seep

Commission orders eliminated the drilling moratorium and required compliance with the Cementing NTO in 2006

The Cementing NTO was revised in 2007, and it currently includes specific requirements for cementing, monitoring, and reporting

Cementing NTO Requirements - General

- Production casing cement required to 500 feet above top of gas (TOG); new 2011 permit conditions and new 2016 isolation report make requirements more stringent
- Production casing annular fluid monitoring and reporting
- Cement bond logs and temperature logs
- Sundry Notice Request to Complete
- Periodic post-cementing bradenhead pressure monitoring
- Remedial procedures (venting or remedial cement) and reporting for bradenhead pressures greater than 150 psi.
- Bradenhead monitoring during stimulation operations

Cementing NTO Requirements - EMCA

The East Mamm Creek Area has additional, more stringent requirements:

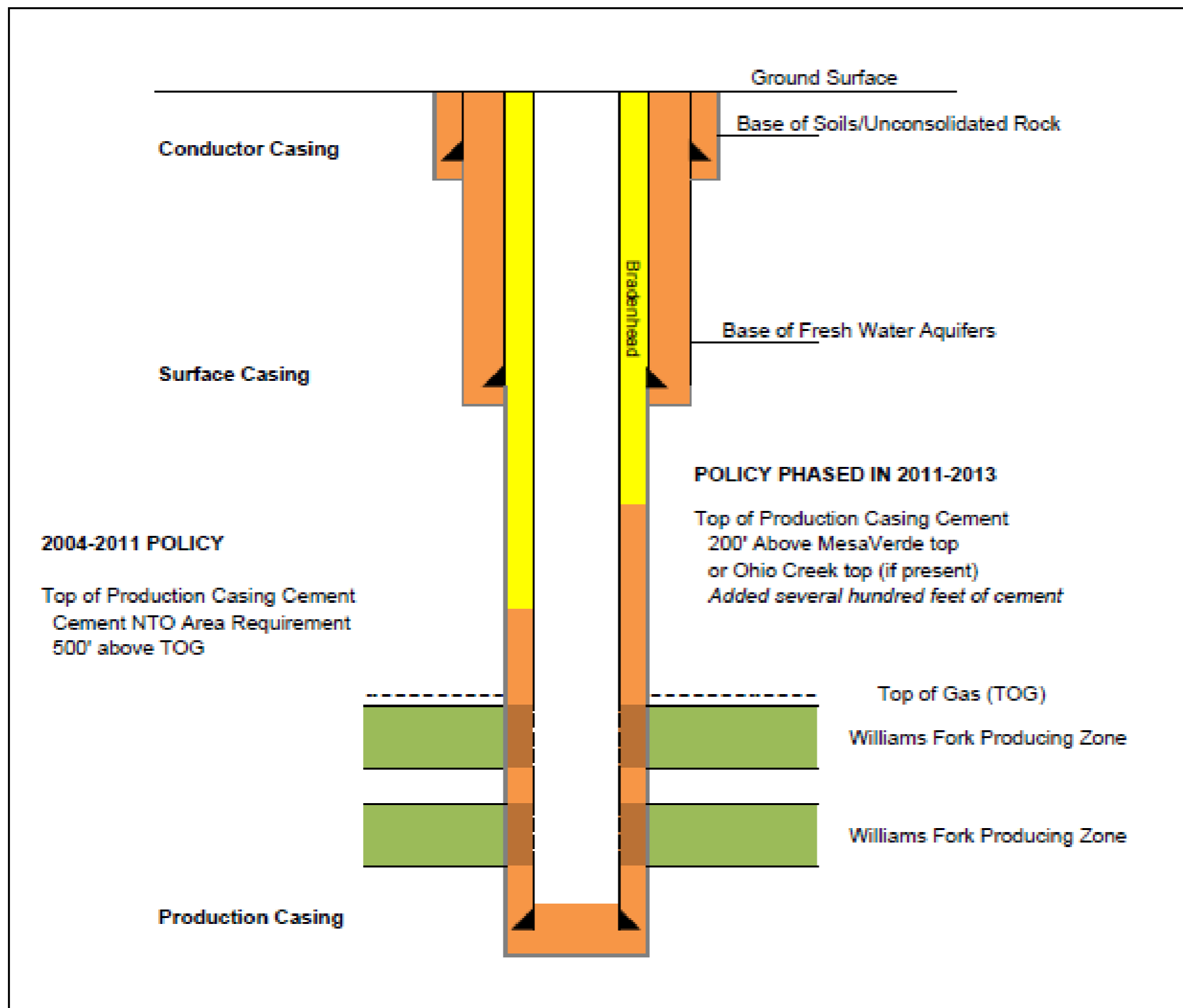
- Surface casing 15 percent of total vertical well depth or 500 feet below the total depth of any water well within a one-mile radius
- Surface casing shoe formation integrity test (FIT) to 13.0 ppg equivalent mud weight.
- Intermediate casing must be set 50 feet below the Mesaverde Group top if the FIT fails
- Choke pressure monitoring relative to FIT pressure
- Daily (30 days) and monthly post cementing bradenhead monitoring for 30 days

Bradenhead NTO Summary

The Bradenhead NTO was published in 2010 to standardize annual bradenhead testing and reporting requirements

- Perform 7-day bradenhead shut-ins, and measure and report pressures annually by November 1
- Mitigation or remedial requirements may be required by COGCC, based on a review of the testing results, and COGCC must approve proposed procedures
- Keep bradenhead pressures below 150 psi
- Use of combustors is encouraged, if feasible based on pressures and flow rates
- Operators must comply with CDPHE-AQCD rules for atmospheric discharges of vented gas

Cement Changes following 2011 Study

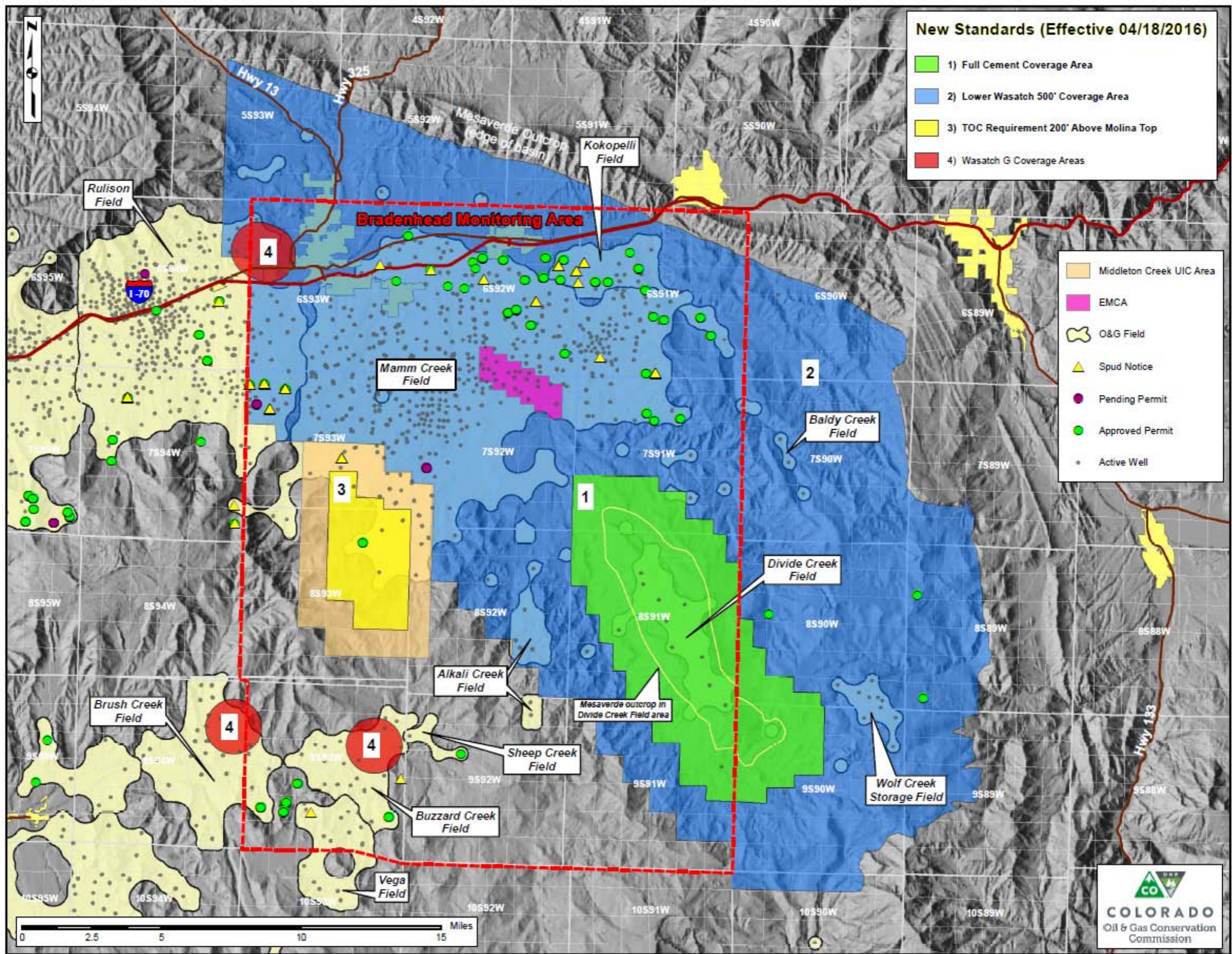


2016 Geologic Isolation Report

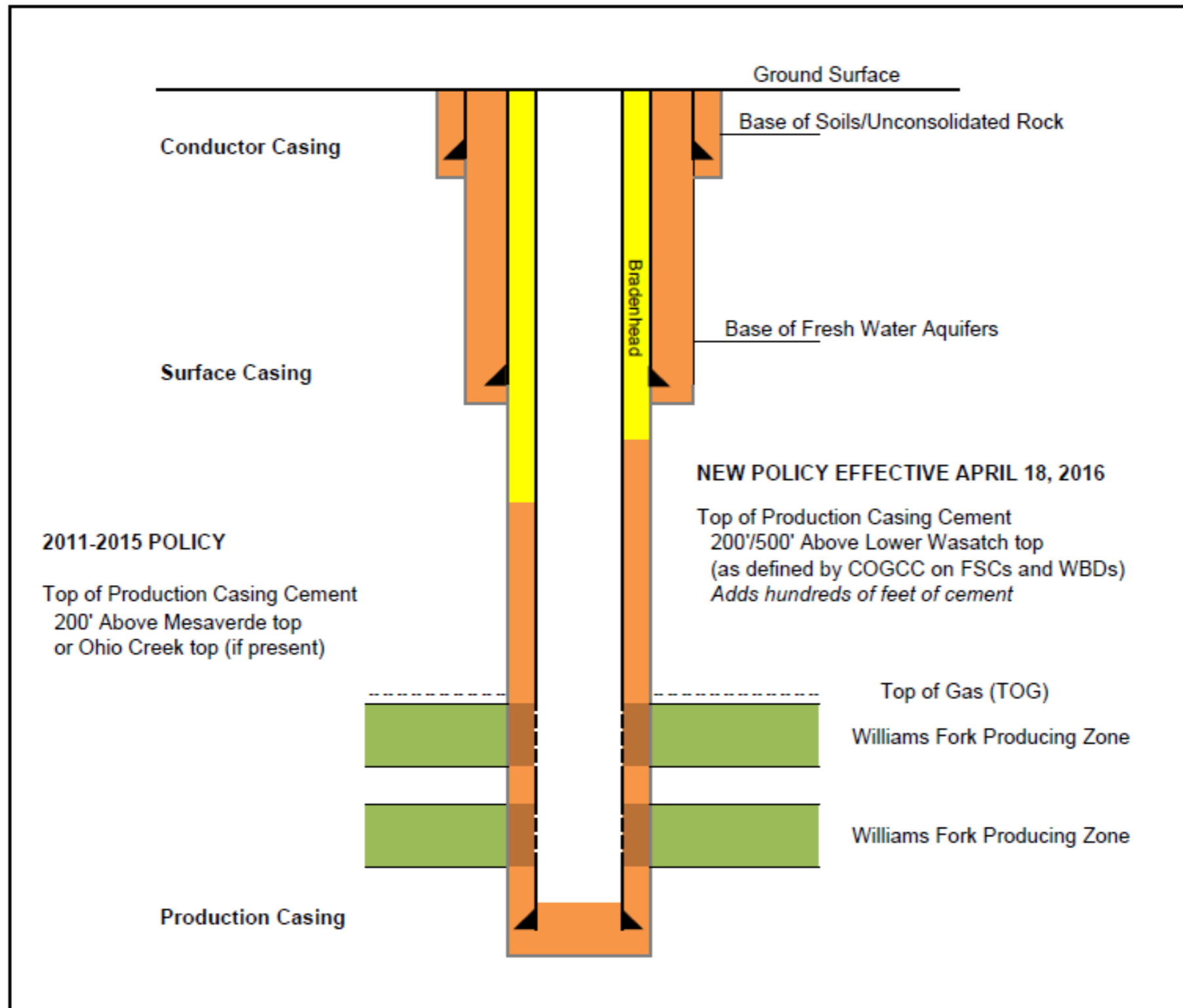
The report was prepared as part of an on-going study to review isolation needs for all gas fields within the BMA and nearby fields

- New cement requirements to cover the Lower Wasatch, as defined by COGCC
- Clarifies coverage requirements for isolation of Wasatch G Sand offset production and Wasatch Underground Injection Control (UIC) disposal intervals
- Full cementing of the Wasatch Formation is not planned in most areas
- More stringent bradenhead remediation and enforcement strategies will be pursued, for geologic isolation in existing wells, where sustained water flows or gas flows have been observed (the 150 psig NTO screening threshold will still be used for bradenhead gas pressure)

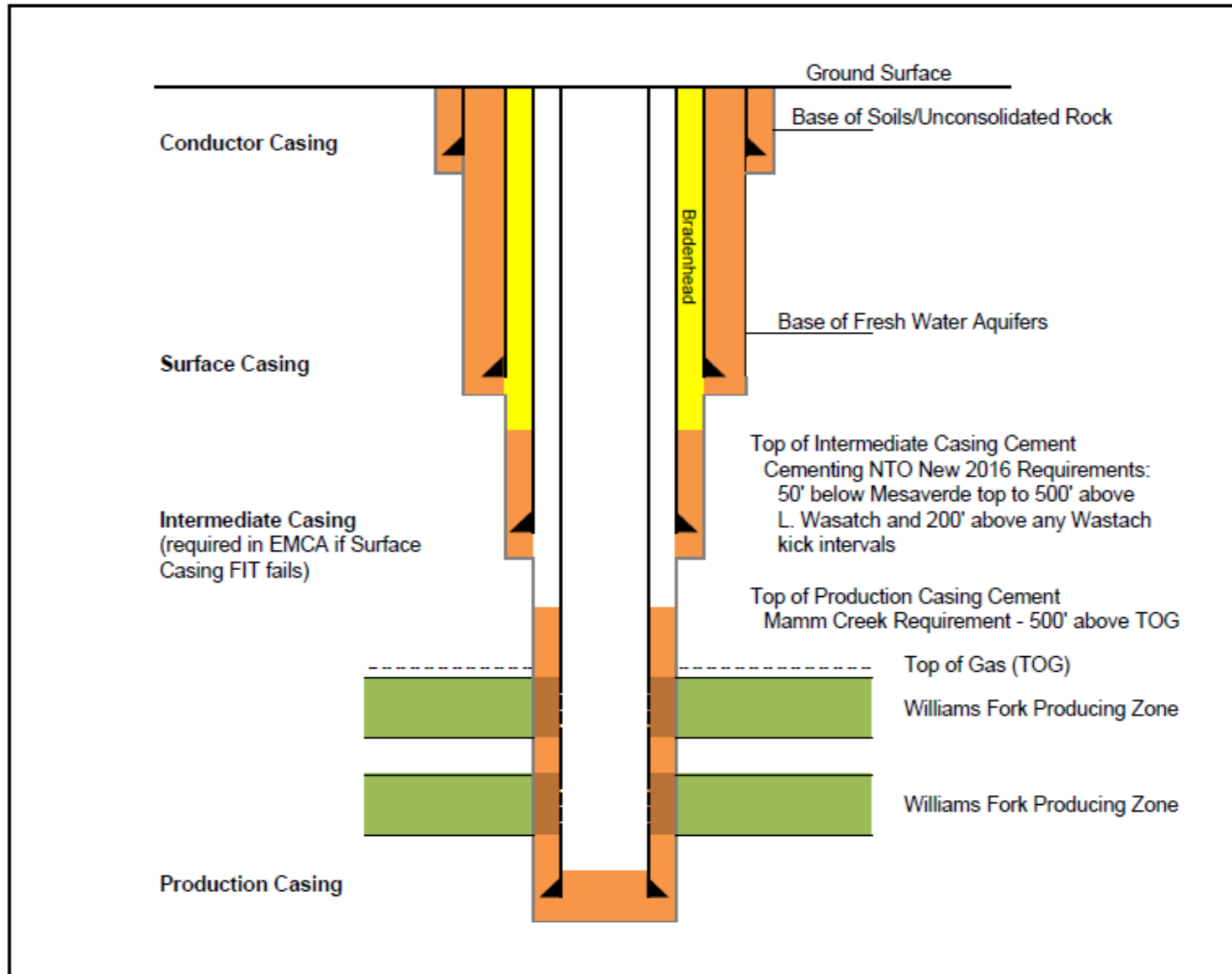
2016 Report Area of Review



New Cement Changes (April 18, 2016)



Cementing NTO EMCA Intermediate Casing Cement Changes (when required)



Wasatch Fm and Ft. Union Fm: Confining Units or Aquifers?

Era	System	Series	Stratigraphic Unit	Unit Thickness (feet)	Physical Description	Hydro-geologic Unit	Saturated Thickness (feet)	Hydrologic Characteristics
Cenozoic	Tertiary	Eocene	Uinta Formation	0-1,400	Silty sandstone, siltstone and marlstone	Upper Piceance Basin aquifer		Conductivity range <0.2 to >1.6 ft/day; yield 1 to 900 gpm; transmissivity 610-770 ft ² /day Conductivity range <0.1 to >1.2 ft/day; yield 1 to 1,000 gpm; transmissivity 260-380 ft ² /d
			Green River Formation	As much as 5,000	Parachute Creek Member kerogenous, dolomitic marlstone and shale 500-1,800 ft	Mahogany confining unit		
					Arvil Points Member shale, fine-grained sandstone and marlstone 0-1,870 ft	Lower Piceance Basin aquifer		
		Wasatch Formation	About 5,000	Garden Gulch Member claystone, siltstone, clay-rich oil shale and marlstone 0-900 ft	Confining unit			
				Douglas Creek Member siltstone, shale and channel sandstone 0-900 ft				
Paleocene	Fort Union Formation	Very thin	Coarse-grained sandstone	Fort Union aquifer				
Mesozoic	Cretaceous	Upper Cretaceous	Mesaverde Group	Averages 3,000 may be >7,000	Fox-Hills Sandstone, Lewis Shale, Williams Fork Formation, Iles Formation; sandstone interbedded shale and coal	Mesaverde aquifer	<500-2,000	Ohio Creek Fm not shown
			Mancos Shale	More than 7,000	Mainly shale but Frontier Sandstone may be local aquifer	Mancos confining unit		

U.S. EPA Definition of USDW

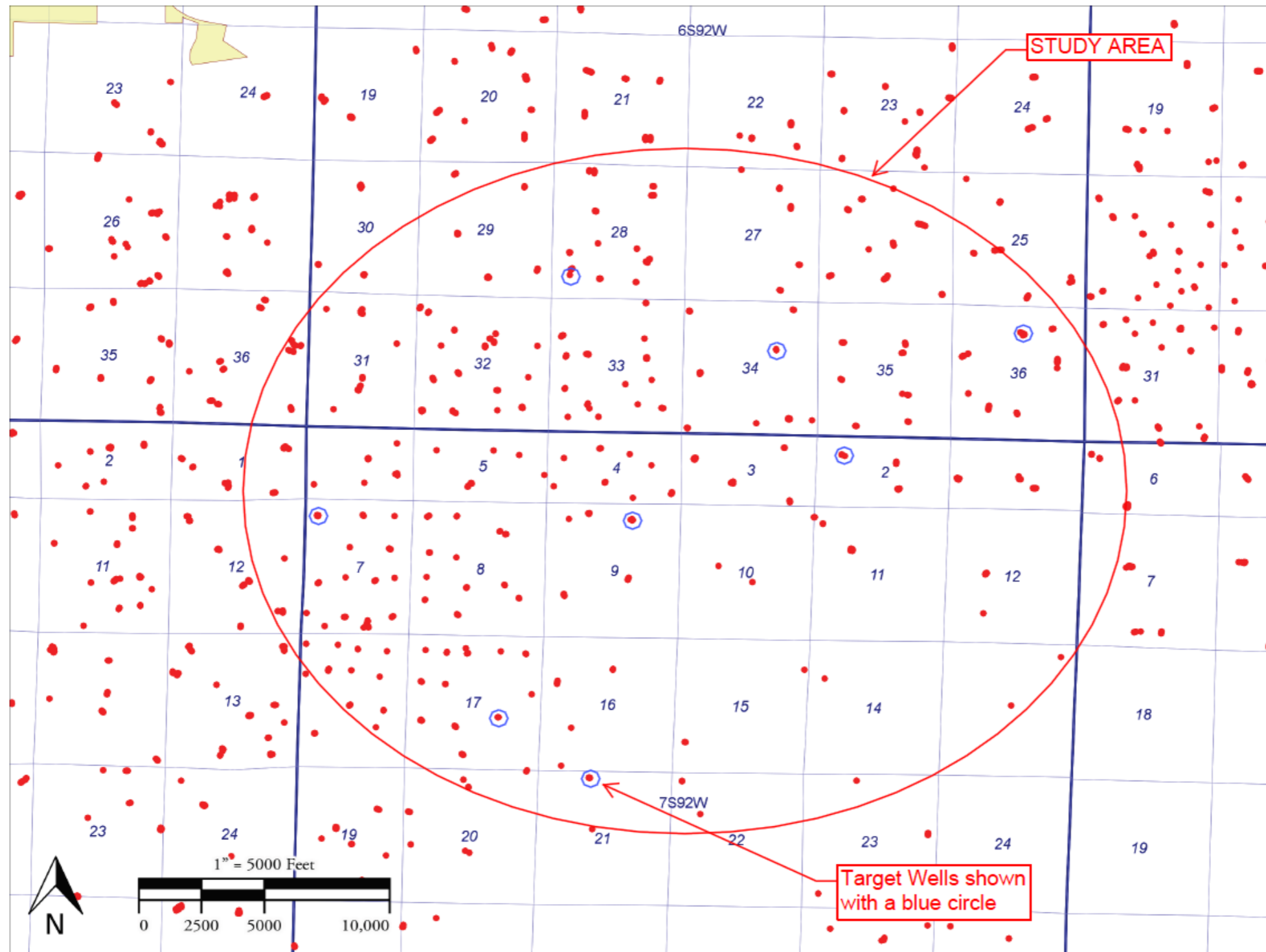
Underground Source of Drinking Water (USDW) - An aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/l total dissolved solids and is not an exempted aquifer (<http://water.epa.gov/type/groundwater/uic/glossary.cfm#t>).

An underline was added to EPA's definition above to emphasize the term "aquifer" and sufficient quantity of groundwater

COGCC contends that sandstones in the Middle Wasatch are not consistent with the term "aquifer" in the definition of a USDW

Petrophysics Studies

Piceance Petrophysics Project - Phase 2



Petrophysics Studies

PICEANCE BASIN PETROPHYSICAL PROJECT - PHASE 2

LOG ESTIMATION OF WASATCH, OHIO CREEK, AND UPPER MESAVERDE FORMATION WATER TDS

TARGET INVESTIGATION AREA: SOUTHERN PORTION OF 6S-92W AND NORTHERN PORTION OF 7S-92W

LIST OF WELLS TO EVALUATE

Well Index	Well Name and Number	API	Legal QQ and Section	Legal Twp Rng	Surface Casing Depth	Log Tops	Log Type	Log Date	Log Document No.
1	Porter Federal #13-28	045-07668	SWSW 28	6S92W	660	2850 OHCRK (COGCC pick) 3165 MVRD (COGCC pick) 3665 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	7/31/2001 7/31/2001	1328861 1328860
3	Stone #42D-34-692	045-10815	SWNE 34	6S92W	728	2680 OHCRK (COGCC pick) 2911 MVRD (Opr pick) 3411 Bottom Depth for Analysis	IND-NEU-DEN-SP-GR TIF file and LAS file	09/10/2005	460923 700002550
5	Scott #2-36	045-07929	NWNE 36	6S92W	650	2887 OHCRK (COGCC pick) 3125 MVRD (COGCC pick) 3625 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	11/21/2001 11/21/2001	1104974 1104975
2	Last Dance #13B-2-792	045-12984	NWSW 2	7S92W	1022	2460 OHCRK (COGCC pick) 2705 MVRD (COGCC pick) 3205 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	11/28/2006 11/28/2006	1420484 1420483
6	KRK LTD #7-3	045-06999	NENW 7	7S92W	525	2980 OHCRK (COGCC pick) 3409 MVRD (Opr pick) 3909 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	08/02/1995 08/02/1995	1042138 1042139
4	Dunn #9-2	045-06907	NWNE 9	7S92W	554	2347 OHCRK (COGCC pick) 2525 MVRD (COGCC pick) 3025 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	10/26/1994 10/26/1994	1043787 1043786
7	Sample #T 65-17 P	045-06744	NWSE 17	7S92W	1000	2235 OHCRK (COGCC pick) 2611 MVRD (Opr pick) 3111 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	02/07/1991 03/05/1991	1049328 1049327
8	Buerger Disposal #1 f.k.a. Buerger 21-3A (C21)	045-08973	NENW 21	7S92W	722	2060 OHCRK (COGCC pick) 2302 MVRD (COGCC pick) 5400 Bottom Depth for Analysis	IND-SP-GR, TIF file NEU-DEN-GR, TIF file	12/31/2002 12/31/2002	1274246 1274245

Petrophysics Studies



LESA 9.8, © 1992-2015 Digital Formation, Inc.

File: 05045076680000 Porter Federal #13-28.lbs

Well Name: PORTER FEDERAL #13-28

Plot: Salinity by Depth

Gross Interval: 660 to 3665 by 0.5 F

Ranges:

660-3665

Time: 10:53 AM

Date: Fri, Jun 12, 2015

Section: SECTION

Township: TOWNSHIP

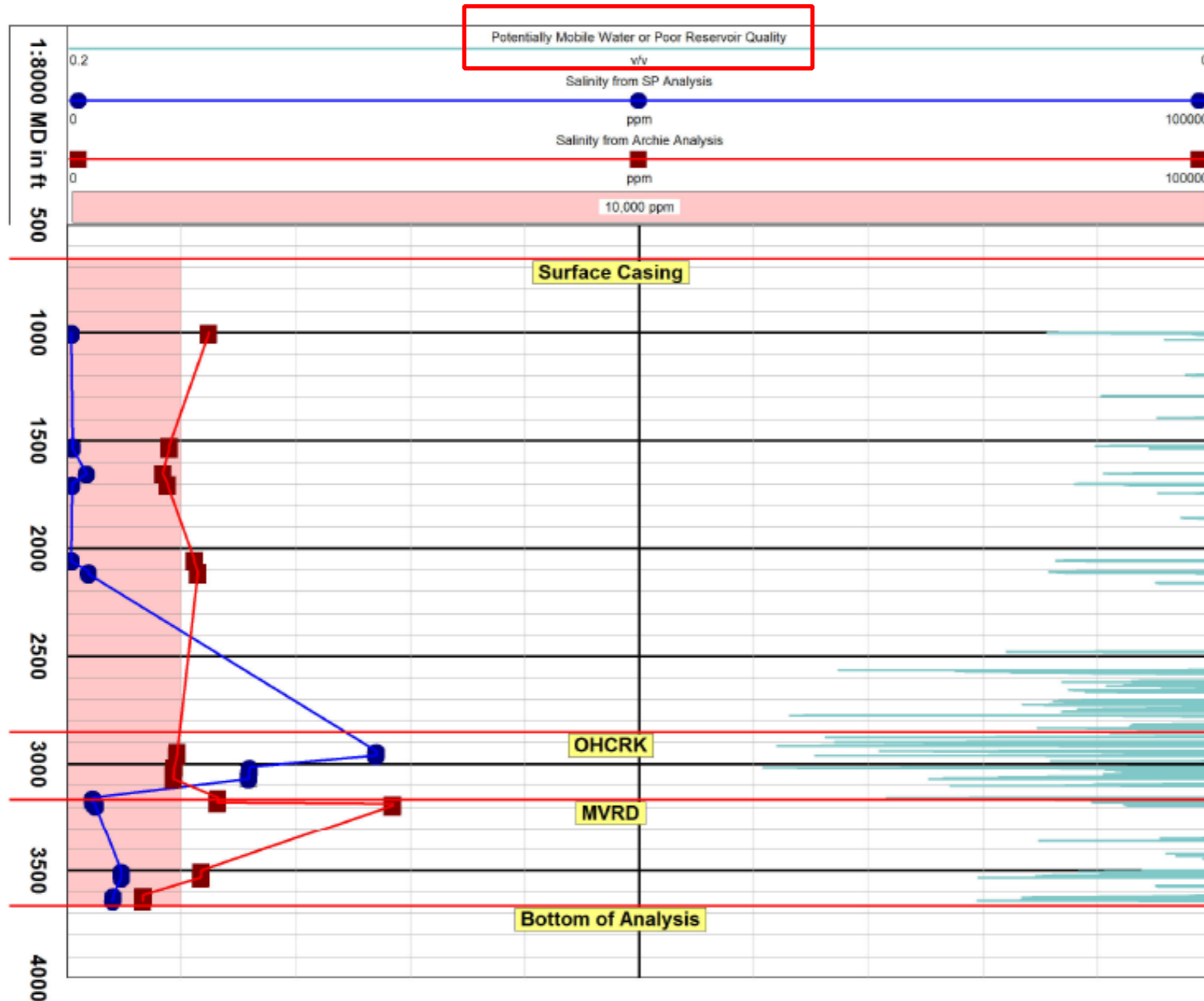
API #: 05045076680000

Location: LOCATION

Range: RANGE

UWI: 05045076680000

Comments:

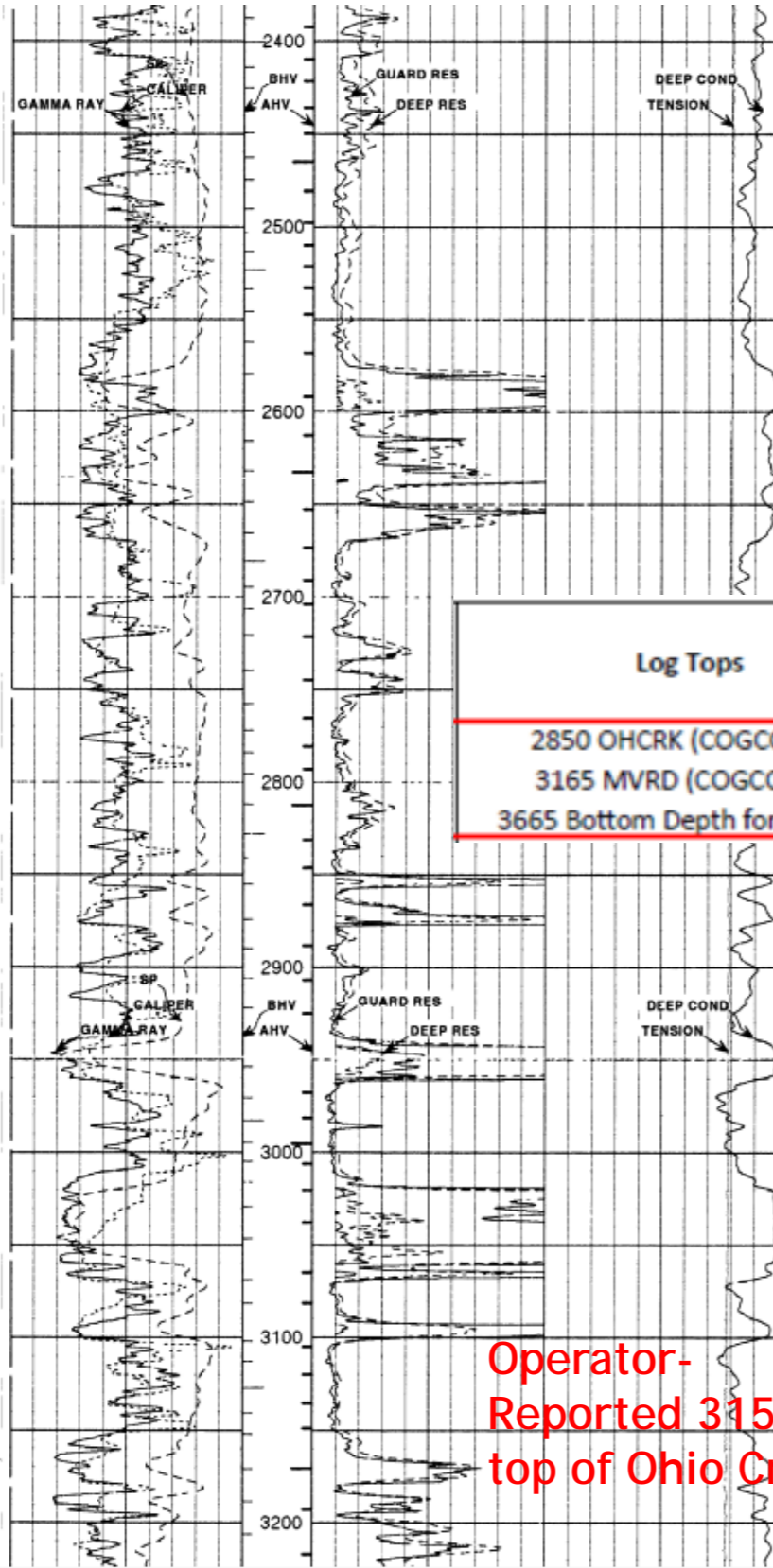


Operator observations in 2016 Geologic Isolation Report support COGCC contention that "Middle" Wasatch water is primarily immobile - bound to shales and shaly sands with "Poor Reservoir Quality"

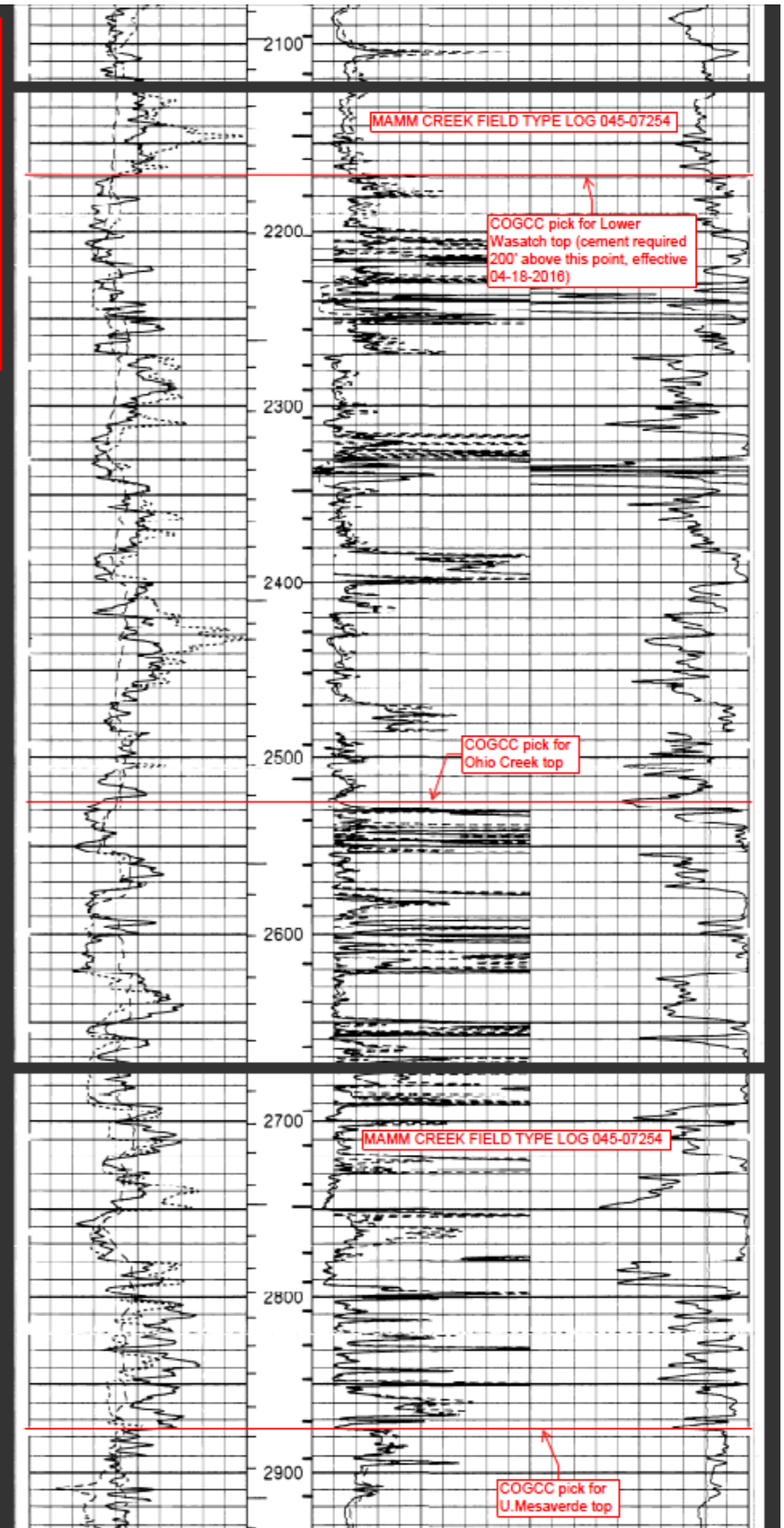
Significant Change Below 2,500' (includes "Lower" Wasatch, overlying Ohio Creek; higher likelihood for "Potentially Mobile Water"

Annotated Type Logs with Fm Tops (L. Wasatch and Ohio Creek)

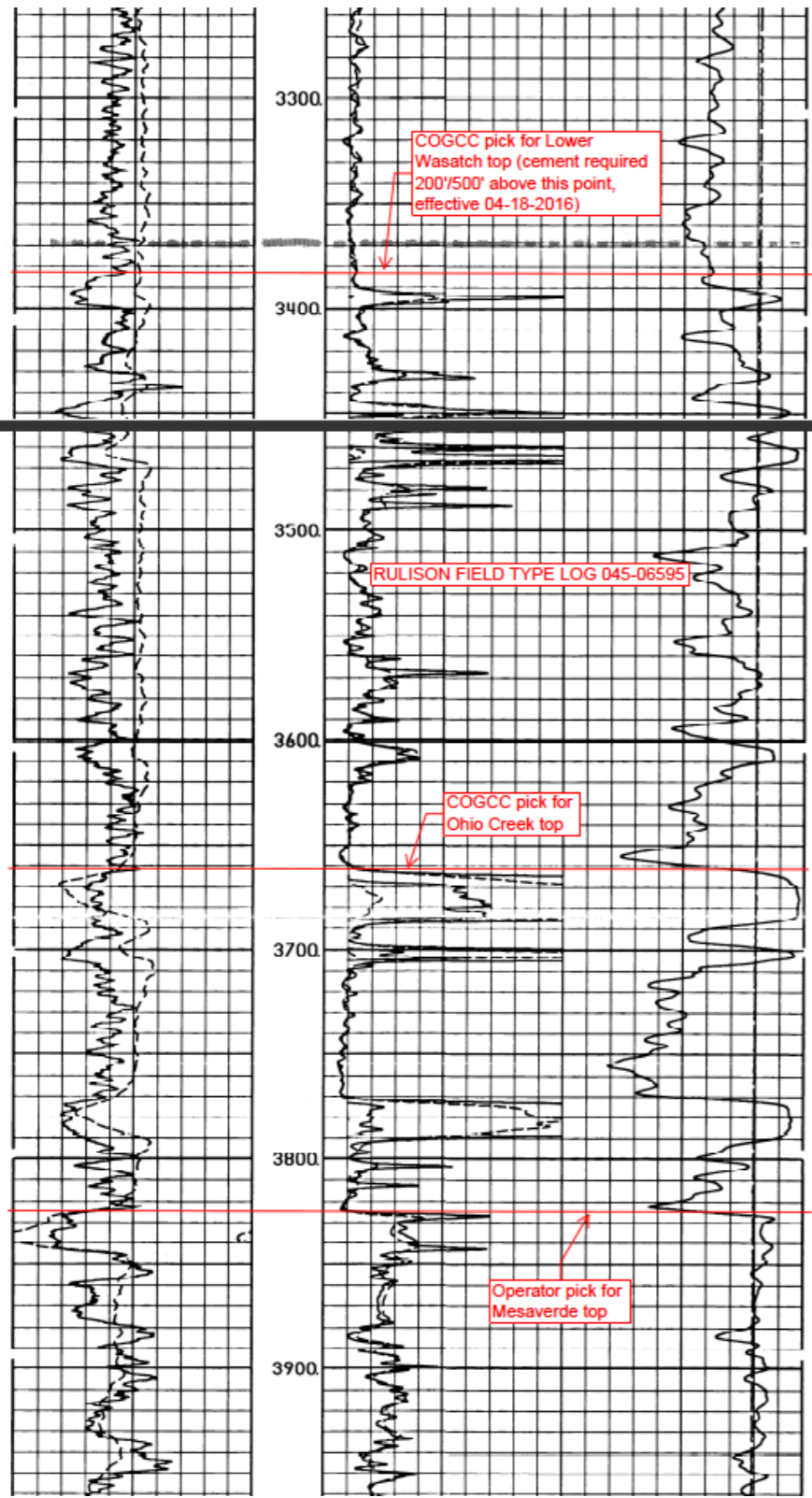
Porter Federal 13-28



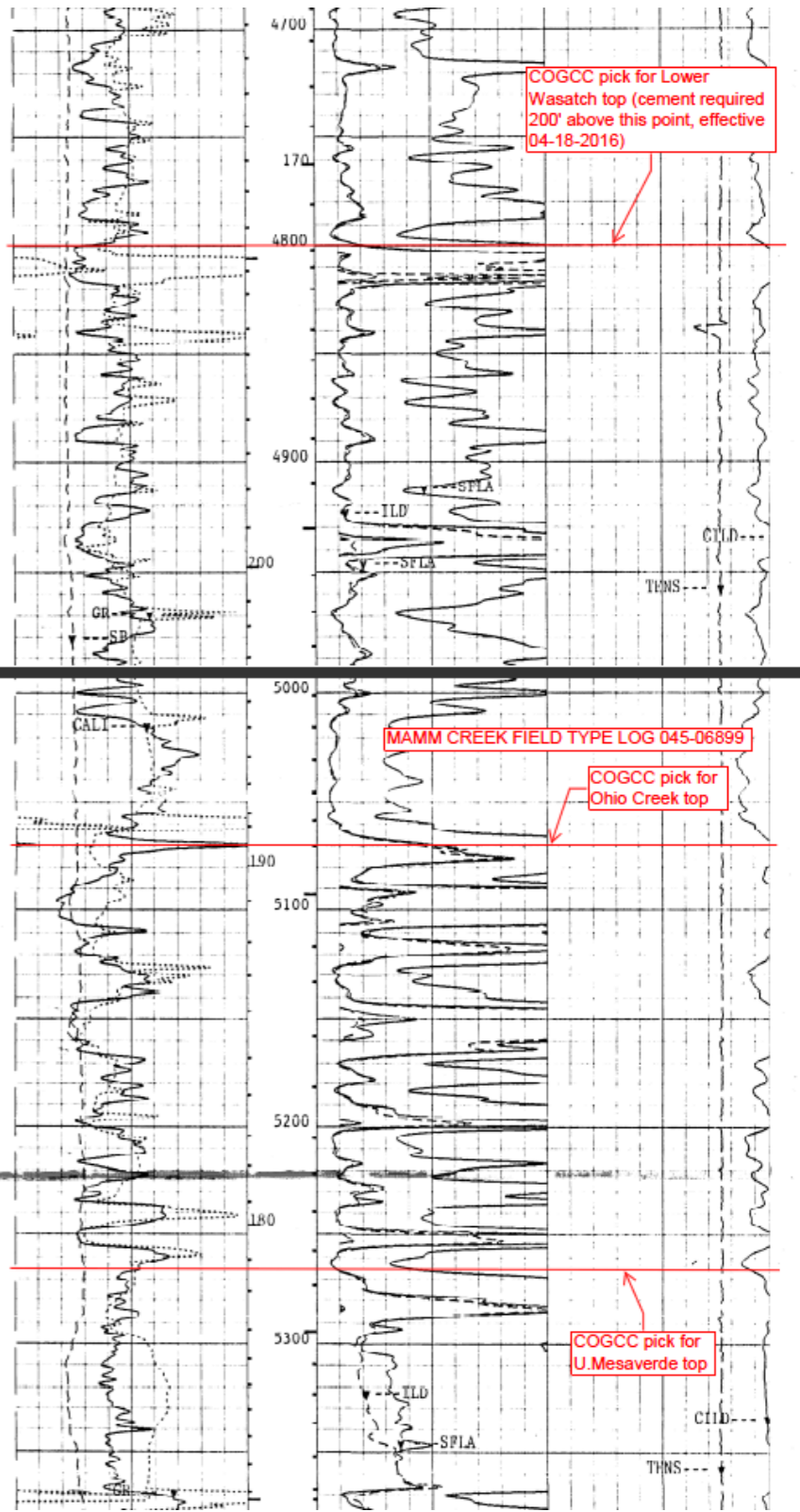
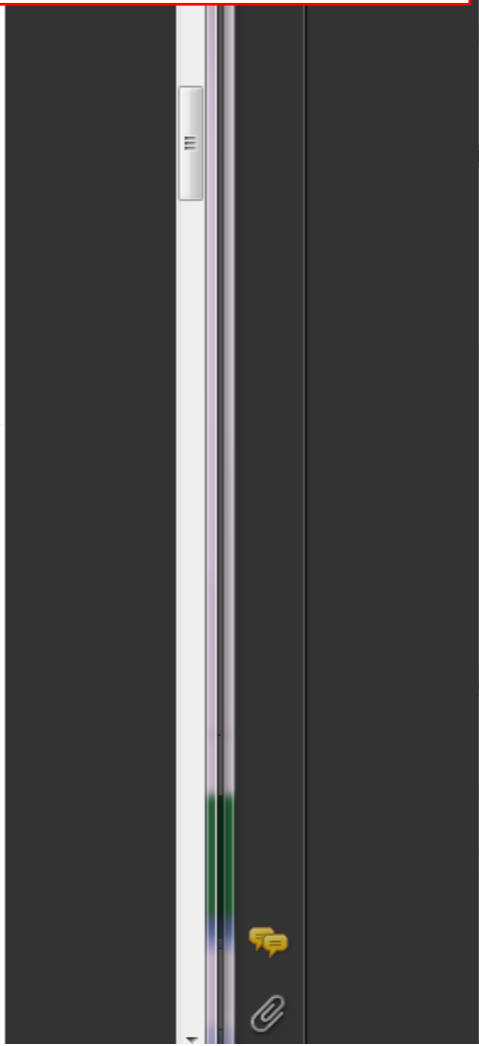
4/19/2016: See Report Appendix A Corrections. Changed the 045-07254 Type Log Lower Wasatch note to "COGCC pick for Lower Wasatch top (cement required 500' above this point, effective 04-18-2016)," consistent with the report text and Report Figures 1 and 2.



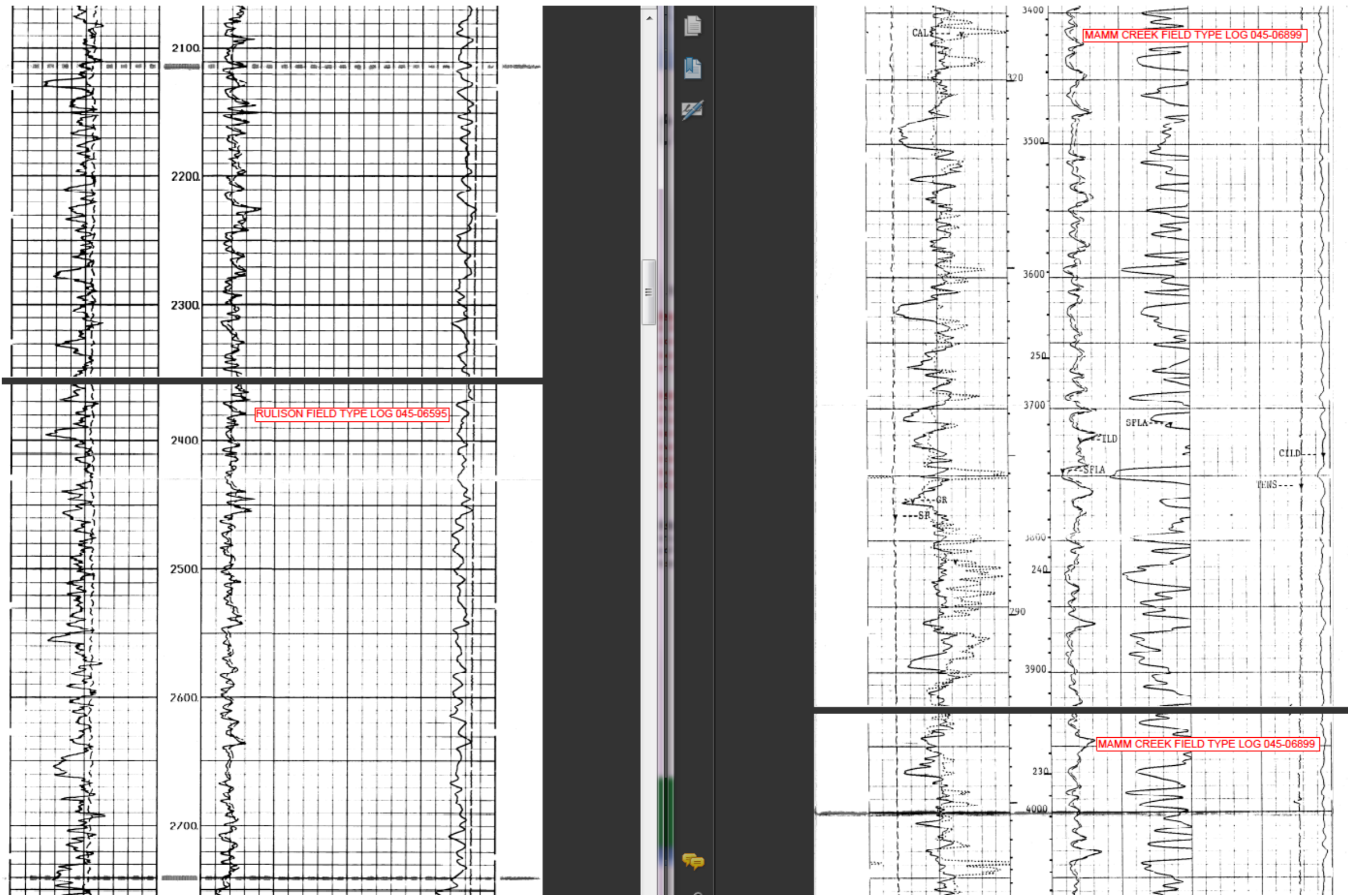
Annotated Type Logs with Fm Tops (L. Wasatch and Ohio Creek)



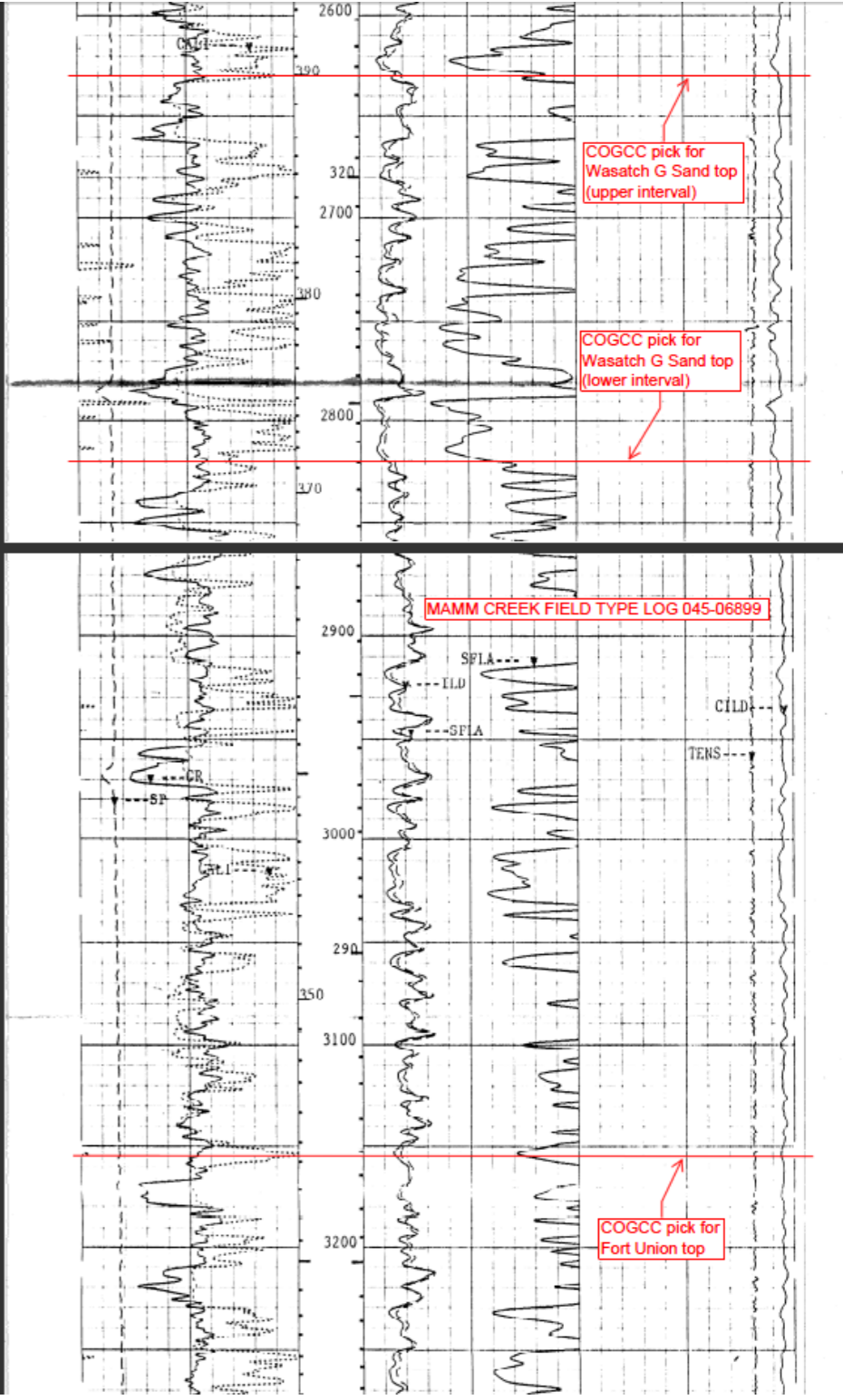
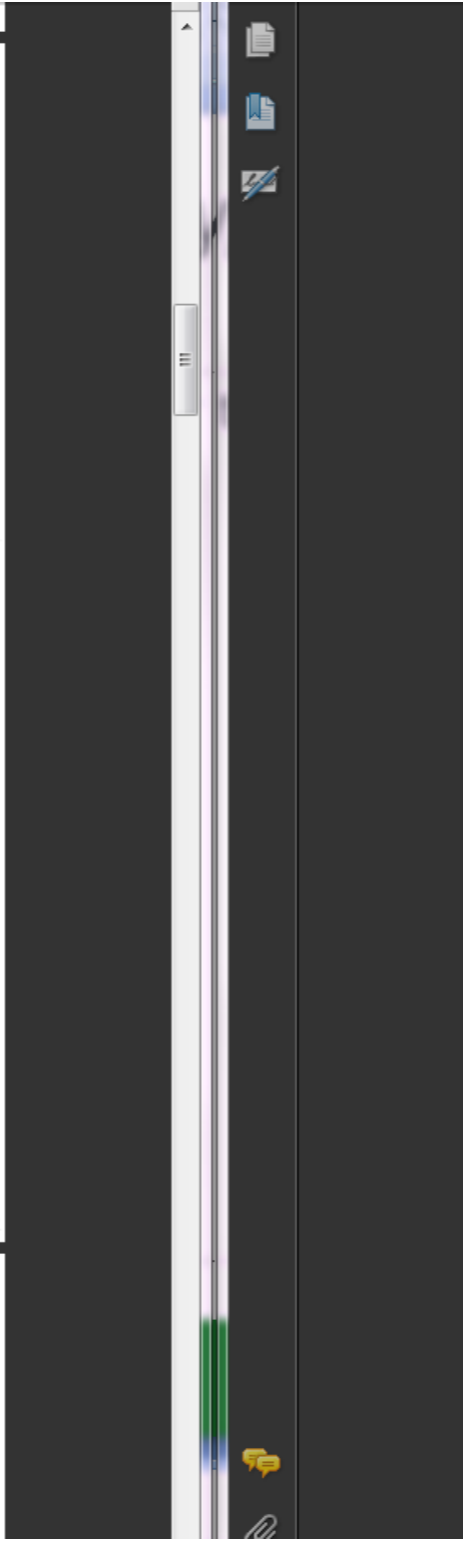
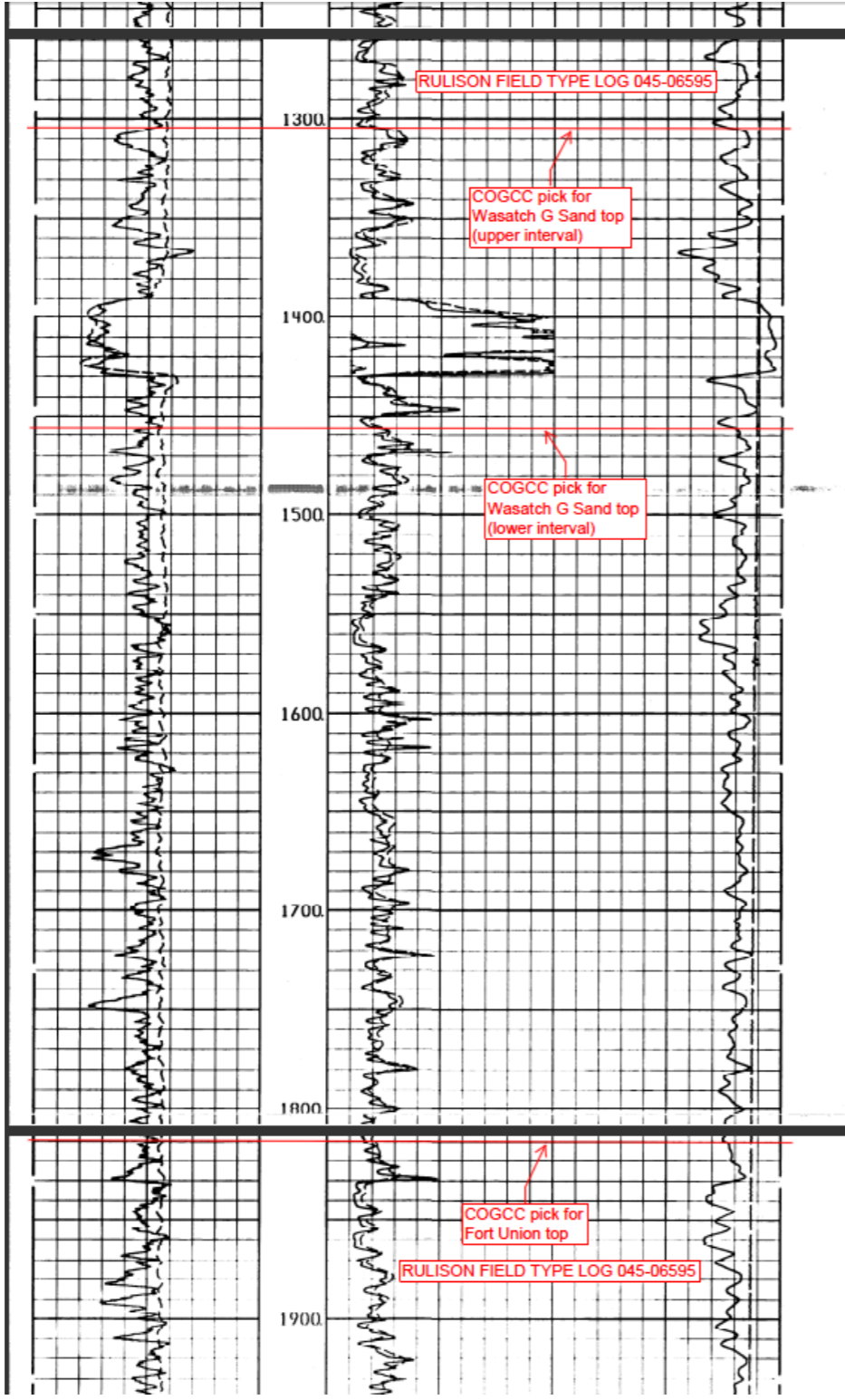
4/19/2016: See Report Appendix A Corrections.
Changed the 045-06899 Type Log Lower Wasatch note to "COGCC pick for Lower Wasatch top (this well is in the Middleton Creek UIC area; see cement top requirement above [refers to note for Wasatch G Upper Interval on the Type Log]; 200' above Wasatch G [equivalent to operator-defined Molina Member top])," consistent with the report text and Report Figures 1 and 3.



Middle Wasatch Induction Log Response



Annotated Type Logs with Fm Tops (Wasatch G Sand & Ft. Union)



Mamm Creek Field Scout Card

COGCC OIL AND GAS FIELD SCOUT CARD

Date 04/18/2016
Document No. 2056127

FIELD NAME MAMM CREEK
FIELD NUMBER 52500

LOCATION

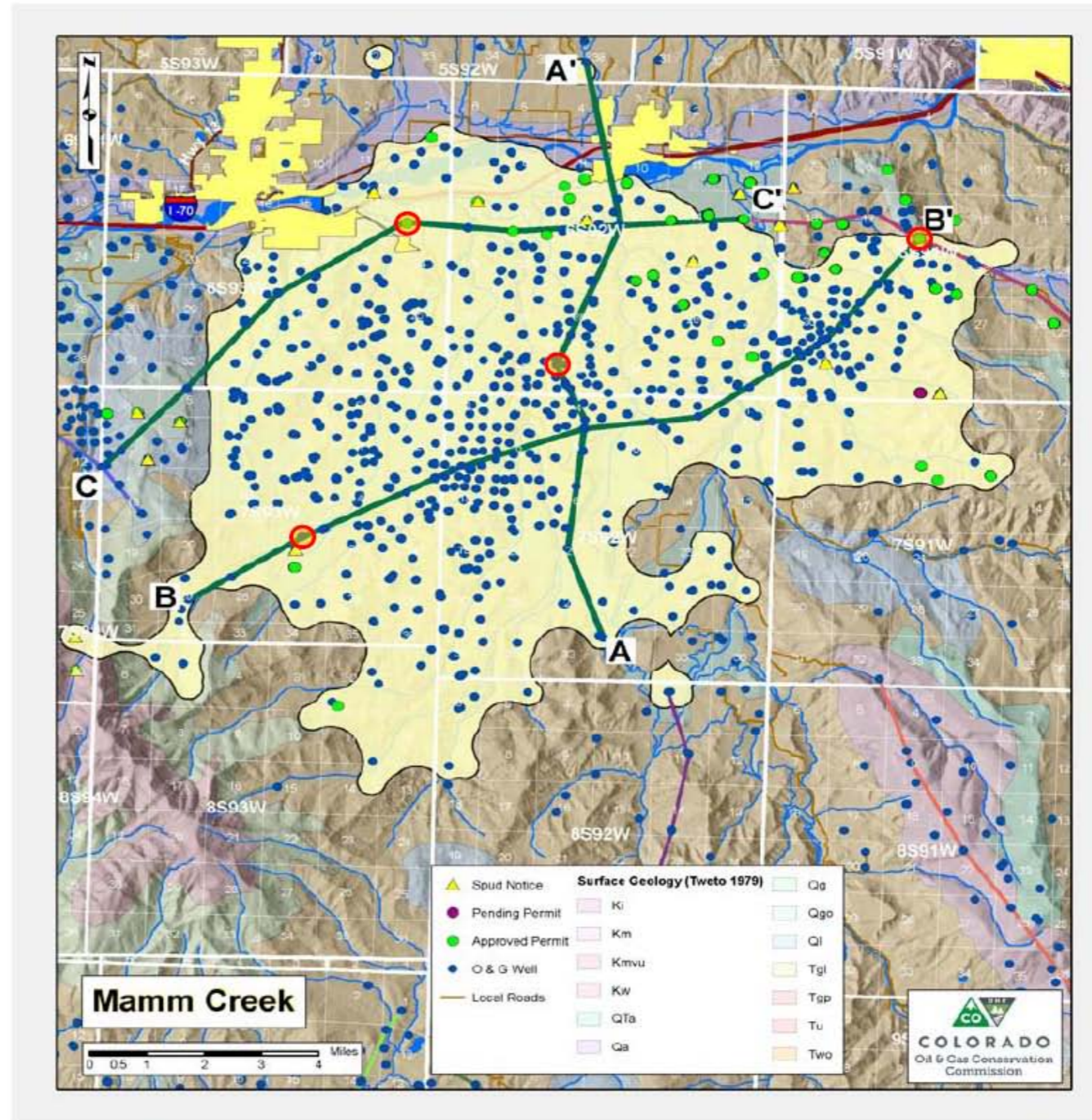
Basin Piceance
Township(s) 5S to 8S
Range(s) 91W to 93W

SURFACE GEOLOGY

The Wasatch Formation outcrops at surface throughout most of the field. The Colorado River generally flows from east to west along the northern fringe of the field. Most of the field is south of the Colorado River. Alluvium is prevalent along the Colorado River and tributary creeks. Landslide deposits are present in the western portion of the field along Ramsey Gulch (primarily in 7S93W). The Green River Formation is present, overlying the Wasatch Formation, in the extreme southwestern portion of the field at higher elevations, approaching the eastern end of Battlement Mesa.

GEOLOGIC STRUCTURE

The northwestern extension of a northwest - southeast trending anticline is present on COGCC's 250K GIS Geology layer in the southeast portion of the field (7S92W). A northwest-southeast trending, southwesterly-dipping monocline (the Grand Hogback Monocline along the northeastern edge of the basin) is present within three miles of the extreme northeastern portion of the field (bordering Kokopelli Field) and the extreme northern portion of the field (locally known as Peach Valley).



○ Type Log Wells

Mamm Creek Field Scout Card

COGCC OIL AND GAS FIELD SCOUT CARD
MAMM CREEK 52500

			B - Southwest					B' - Northeast			
STRATIGRAPHY			API Number =>	045-15910	045-06899	045-07040	045-06907	045-09306**	045-10341	045-07152	045-14576
All depths are measured depths			Surface Elevation =>	7,676	6,889	6,165	6,103	6,160	5,911	5,978	6,792
			Well Type =>	Directional	Vertical	Vertical	Vertical	Vertical	Directional	Vertical	Directional
Group	Formation	Member	Isolation Concern	Log Top	Log Top	Log Top	Log Top	Log Top	Log Top	Log Top	Log Top
	Alluvium		Water	///	0	0	///	///	0	///	0
	Landslide Deposit		Water	///	///	///	///	///	///	///	///
	Uinta		Water	///	///	///	///	///	///	///	///
	Green River		Water	///	///	///	///	///	///	///	///
	Wasatch		Shallow Water	0	..	..	0	0	..	0	..
	Wasatch	G-Sand*	Possible Gas	3,758/3928*	2,630/2820*	820/1,003*	..	194/278*	784/878*	780/860*	1,120/1,262*
	Wasatch	Fort Union*	None	4,276	3,154*	1,307*	..	736*	1,373*	1,352*	1,650*
	Wasatch	Middle	UIC	..	..	..	..	..	..	..	..
	Wasatch	Lower*	Water / UIC	5,610*	4,800*	2,660*	1,910*	2,094*	2,754*	2,730*	3,356*
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	5,895*	5,070*	3,038*	2,330*	2,325*	3,095*	3,040*	3,543*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	6,389	5,266*	3,302*	2,522*	2,652*	3,386	3,400*	3,914*
Mesaverde	Williams Fork	Top of Gas	Gas	7,546					4,535 tog***	4,134	
Mesaverde	Williams Fork	Cameo	Gas		7,962	6,802	6,088			///	
Mesaverde	Iles	Rollins	Gas / UIC	9,838	8,580	6,930	///	6,299	6,971	///	7,497
Mesaverde	Iles	Cozette	Gas / UIC	10,370	///	///	///	///	///	///	8,047
Mesaverde	Iles	Corcoran	Gas / UIC	10,582	///	///	///	///	///	///	8,242
	Mancos		Possible Gas	///	///	///	///	///	///	///	///
	Niobrara		Possible Gas	///	///	///	///	///	///	///	///

Annotated Type Log for 045-06899: COGCC Document Number 2056128

Annotated Type Log for 045-14576: COGCC Document Number 2056080 (Kokopelli Field)

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

* COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)

** Schwartz 2-15B (O2) - well associated with West Divide Creek seep.

*** Top of Gas (tog), as reported by operator or top Williams Fork production perforation (tp)

Mamm Creek Field Scout Card

WATER RESOURCE ISOLATION

Alluvium, landslide deposits, Uinta, Green River, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde.

Water wells are typically screened in alluvium or upper, weathered portions of the Wasatch Formation. Two water wells north of the Colorado River are 620' and 750' deep, but otherwise, all permitted water wells within the field have total depths of 600' or shallower.

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork and Iles)

Secondary Objectives: Eight wells completed in the Wasatch Formation (production reported in two wells and one other well was tested then squeezed with cement, some other completions for UIC); two wells completed in the Segó Member of the Iles Formation (045-10599 and 045-18869); seven wells completed in the Mancos Formation; and one well completed in the Leadville Formation (045-06723).

UNDERGROUND INJECTION CONTROL

API Number	Well Name and No.	Type	Zone	Sample Top	Sample Bot.	TDS	Source
045-09403	HMU #14-8 (P11SW)	Disposal Fm	Wasatch ¹	N/A	N/A	8,200	WH - 6/9/2009
045-10146	MCU Disposal #3	Disposal Fm	Wasatch ¹	N/A	N/A	8,200	WH - 6/9/2009
045-10123	MCU Fed. Disp #2	Disposal	Wasatch	4,562	5,198	8,200	WH - 6/9/2009
045-11225	MCU Disposal #1	Disposal	Wasatch	4,108	4,962	27,000	LOG CALC - OGCC
045-07463	BJM Disposal #1	Disposal	Ohio Creek	N/A	N/A	4,350	White River Field UIC Facility ID 159065 ²
045-08973	Buerger Disposal #1	Disposal Test	Ohio Creek ³	2,324	3,096	3,300	WH - 10/28/2010
045-19732	Maves #A1	Source	Williams Fork - Rollins	3,208	5,493	11,367	WH - 11/23/2010
045-06868	Daley #1	Source	Williams Fork	4,076	5,470	5,320	WH - 6/13/2005
045-06928	Broome #1	Source	Williams Fork	4,223	6,434	5,587	WH - 6/13/2005
045-10344	GGU Broome #34C-30-691	Source	Williams Fork	4,400	6,952	9,397	WH - 4/10/2006
045-10343	GGU Broome #44A-30-691	Source	Williams Fork - Rollins	4,442	7,028	10,559	WH - 4/10/2006
045-06819	Duane Scott #1	Source	Williams Fork	4,522	6,354	10,172	WH - 4/13/2006
045-08971	Buerger #16-14C (C21)	Disposal Fm	Williams Fork ⁴	4,617	5,070	18,180	WH - 6/7/2003
045-13482	GGU Miller #11B-32-691	Source	Williams Fork	4,715	6,729	18,409	WH - 9/30/2005

Aquifer Exemptions: BJM Disposal #1 (Ohio Creek) [data may not be representative of actual Ohio Creek Formation concentration] and MCU Federal Disposal #2 (Atwell Gulch Member of Wasatch) [tops reported as 3298' Molina Member, 3509' G-Sand interval, and 3764' Atwell Gulch Member of Wasatch]

Data in this table is listed first by zone from shallowest to deepest, then by Sample Top depth.

(1) Sample appears to have been collected from offset well 045-10123 on 6/9/2009 with a P11SW sample name. The Wasatch Formation was not completed in 045-09403 and 045-10146 until 5/25/2013 and 6/7/2012, respectively.

(2) At the time of the UIC Application, the sample was considered representative of the Ohio Creek Formation. The sample was collected from a well in the White River Dome Field, Rio Blanco County, approximately 54 miles NW of 045-07463. COGCC staff's opinion in 2016 is that this TDS concentration cannot be considered representative of Ohio Creek water quality in the Mamm Creek Field.

(3) Designated the Ohio Creek Formation by the operator, but in 2016 COGCC staff contends that this interval is entirely Upper Mesaverde.

(4) Perfs added from 4,260' to 4,429' on 6/9/2003 after collecting this sample. This sample was a representative formation sample for the Buerger #2 (045-09003) UIC application.

Mamm Creek Field Scout Card

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

191-1 (12/14/1965)	Mesaverde: Recognizes the Mesaverde as a <u>Common Source</u> of supply. Established 640-acre drilling and spacing units. Order specifies minimum 350' surface casing with size and weight of casing approved by COGCC. Requires sufficient cement be used to fill the annular space behind the pipe to the surface.
191-2 (5/18/1981)	Rescinds 191-1 and makes lands subject to the general rules and regulations.
191-3 (7/19/1982)	Mesaverde: Established 640-acre drilling and spacing units, 990' from unit boundary. Recognizes the Cozzette and Corcoran to be part of the Upper Mancos formation as a <u>Common Source</u> of supply with the Mesaverde.
191-4 (2/22/1994)	Expand areas of 640-acre drilling and spacing.
191-5 (10/20/1997)	Mesaverde including Williams Fork: decreased spacing unit size to 40 acres, 400' from unit line, 800' well-to-well in one section (16 wells per 640 acres).
1V-276 (8/16/2004)	West Divide Creek Seep Order Finding Violation: Moratorium on drilling within 2 miles of the Divide Creek Seep until the appropriate safety precautions are set forth in the Notice to All Operators Drilling Wells to the Mesaverde Group or Deeper in the Mamm Creek Field, Garfield County, effective July 23, 2004 (Cementing NTO); penalty assigned to EnCana Oil & Gas (USA) Inc. for the Schwartz 2-15B well.
Various	Williams Fork and Iles: established 640, 320, 160, and 80-acre drilling and spacing units in certain parts of the field with 10 acre well density (no more than 4 wells on one pad per quarter quarter section, to be drilled vertically or directionally), 100' from boundary lines or 200' (Williams Fork) / 400' (Iles) from boundaries if offset wells are not 10-acre spaced.
191-12 (7/11/2005)	Allows drilling by BBC in a portion of the Order 1V-276 moratorium area. Requires compliance with 2004 Cementing NTO, Bradenhead Testing and Reporting Requirements for the Mamm Creek Field (Aug 23, 2004), BBC's Ground Water and Methane Monitoring Plan, walking surveys within 1/2 mile of drill site, surface water samples prior to drilling and after completion, monthly monitoring of surface water during drilling, and defines sampling analytes. Requires gas compositional and stable isotope analysis if methane detected at > 2 mg/L. Requires compliance with BBC's Additional Subsurface Data Collection Plan (including Wasatch gas sample collection during drilling surface hole, if practicable). Requires compliance with BBC's Mamm Creek Field Operations Plan dated Dec 2004 and concerns and conditions expressed in the July 4, 2005 correspondence from Garfield County's consultant, Dr. Geoffrey Thyne. Sample results were to be submitted to to augment hydrogeologic study.
191-22 (9/20/2004)	Established Bradenhead Monitoring Area, including the Mamm Creek Field.
191-23 (4/24/2006)	Eliminated the Order 1V-276 drilling moratorium area within 2 miles of Divide Creek Seep. Operators drilling in the area are required to comply with the Cementing NTO.
Various	Mancos Group: established various drilling and spacing units with 10 acre well density (no more than 4 wells on one pad per quarter quarter section) for the Mancos Group, including the Mancos, Niobrara, and Mowry Formations, 100' from boundary lines or 400' from boundaries if offset wells are not 10-acre spaced.
Various	Williams Fork: Established horizontal wellbore spacing units

Mamm Creek Field Scout Card

HISTORIC WELL CONSTRUCTION

Historic surface casing setting depths vary throughout the field as a function of age of the well and ground surface elevation. Old wells drilled during early development of the field commonly have surface casing setting depths ranging from 200' to 500' deep. Effective 11/20/1997, the minimum surface casing setting depth standard was changed to 10% TVD for all Williams Fork gas wells drilled in Garfield County, which includes this entire field. Effective 2/9/2007, the minimum surface casing setting depth was increased to 15% TVD for wells drilled in the East Mamm Creek Area. Surface casing setting depths for newer wells are generally set between 1,000' to 3,000', but deeper surface casing (3,000' to 4,000') has been used in isolated areas of the field. Production casing generally terminates in the Iles Formation or the underlying Mancos Formation. Production casing cement (or intermediate casing cement, if used) may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 10% TVD (or 15% TVD in the East Mamm Creek Area) for well control and to cover water resources in the upper interval of the Wasatch Formation. Recommend setting depth of at least 50 feet below the Wasatch Formation top for high-elevation wells that must drill through the Green River Formation, if that criterion is more stringent than the 10% TVD criterion. Check for deep alluvium on offset logs with wells drilled near the Colorado River, but a cursory review of wells with shallow surface casing of 300' to 400' near the river showed that minimum surface casing setting depths will likely provide full coverage of alluvium. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands in the southwest portion of Township 7S-93W (Sections 19, 20, 29, 30, 31, and 32) and the northwest portion of Township 8S-93W (Sections 5 and 6), or at least 500' above Lower Wasatch sands in the northern, central, and eastern portions of the field to the northeast of the Molina/Atwell Gulch Middleton Creek UIC Area, or 200' above the Molina Member top within an area inclusive of a one-mile buffer around the Middleton Creek UIC Area.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Consider setting plug(s) from 1,000' to surface for shallow surface casing strings that are less than 1,000 feet deep.

WELL CONTROL

Well control events summarized below were controlled without incident. The 2004 Schwartz 2-15B (O2) underground blowout to West Divide Creek was uncontrolled until cement remediation was performed, with gas kicks encountered in the Wasatch (rare occurrence) and Williams Fork. Well Control events have been reported in 6S-92W, 6S-93W, 7S-91W, 7S-92W, 7S-93W, and 7S-94W.

Well Control Reports (Form 23s) by Year: 2003 (1), 2004 (1), 2005 (1), 2006 (1), 2007 (2), 2008 (3), 2009 (5), 2010 (9), 2011 (18), 2012 (18), 2013 (3), 2014 (none), and 2015 (none). Reporting was inconsistent prior to 2009, when requirements for Form 23 reporting was emphasized with the operators.

Form 23s by Formation: Williams Fork (40), Iles [including Segó Member] (14), and Mancos/Niobrara (9)

NOTES

Except for T5S, the entire field is located within the Mamm Creek Field Cementing Notice to Operators Area. Special requirements and Form 2 Conditions of Approval apply.

Except for T5S, the entire field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

An Uranium Mill Tailings Remedial Action area is located along I-70 and the Colorado River to the northwest of the field in 6S93W. Special requirements and Form 2 Conditions of Approval apply.

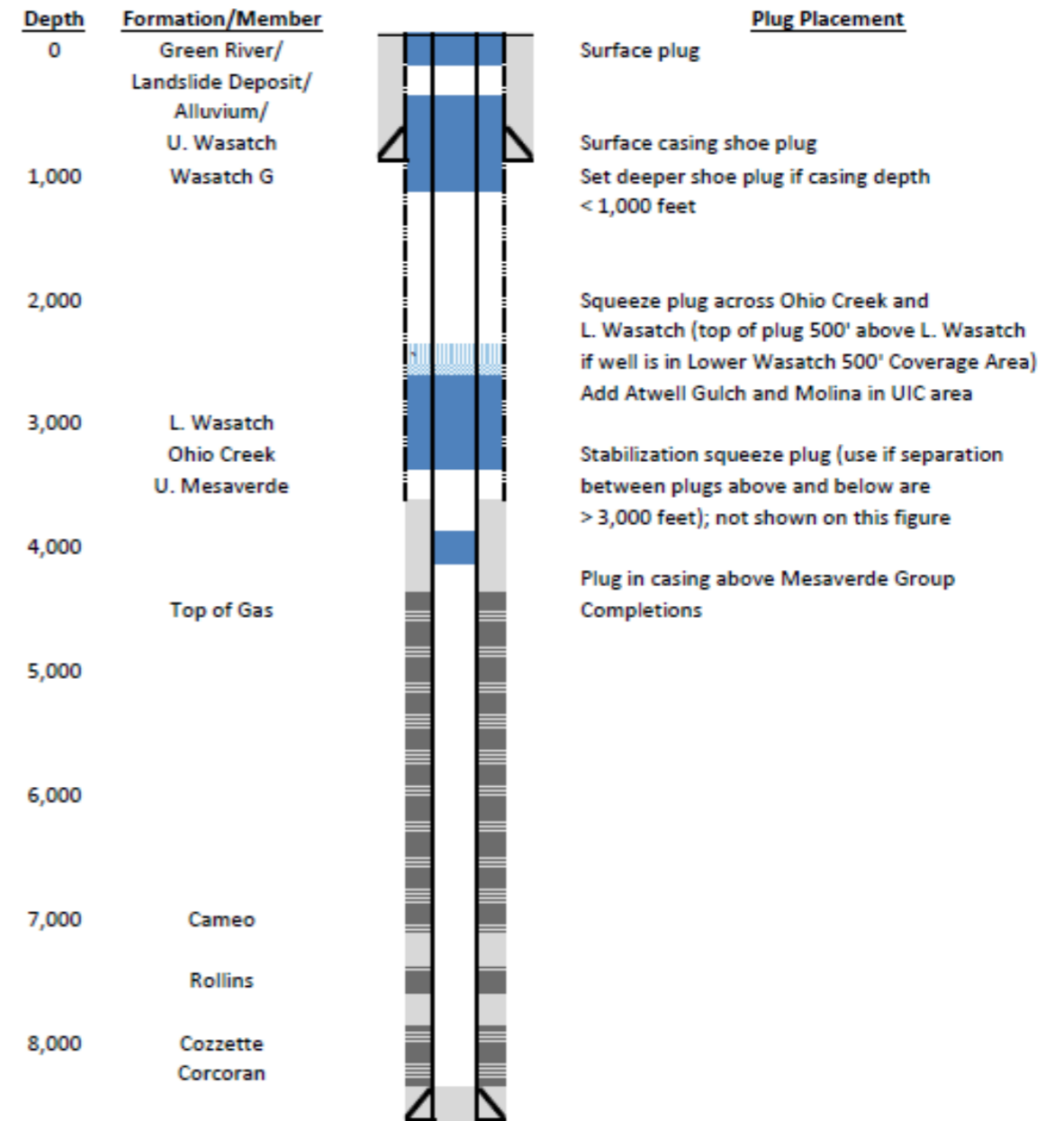
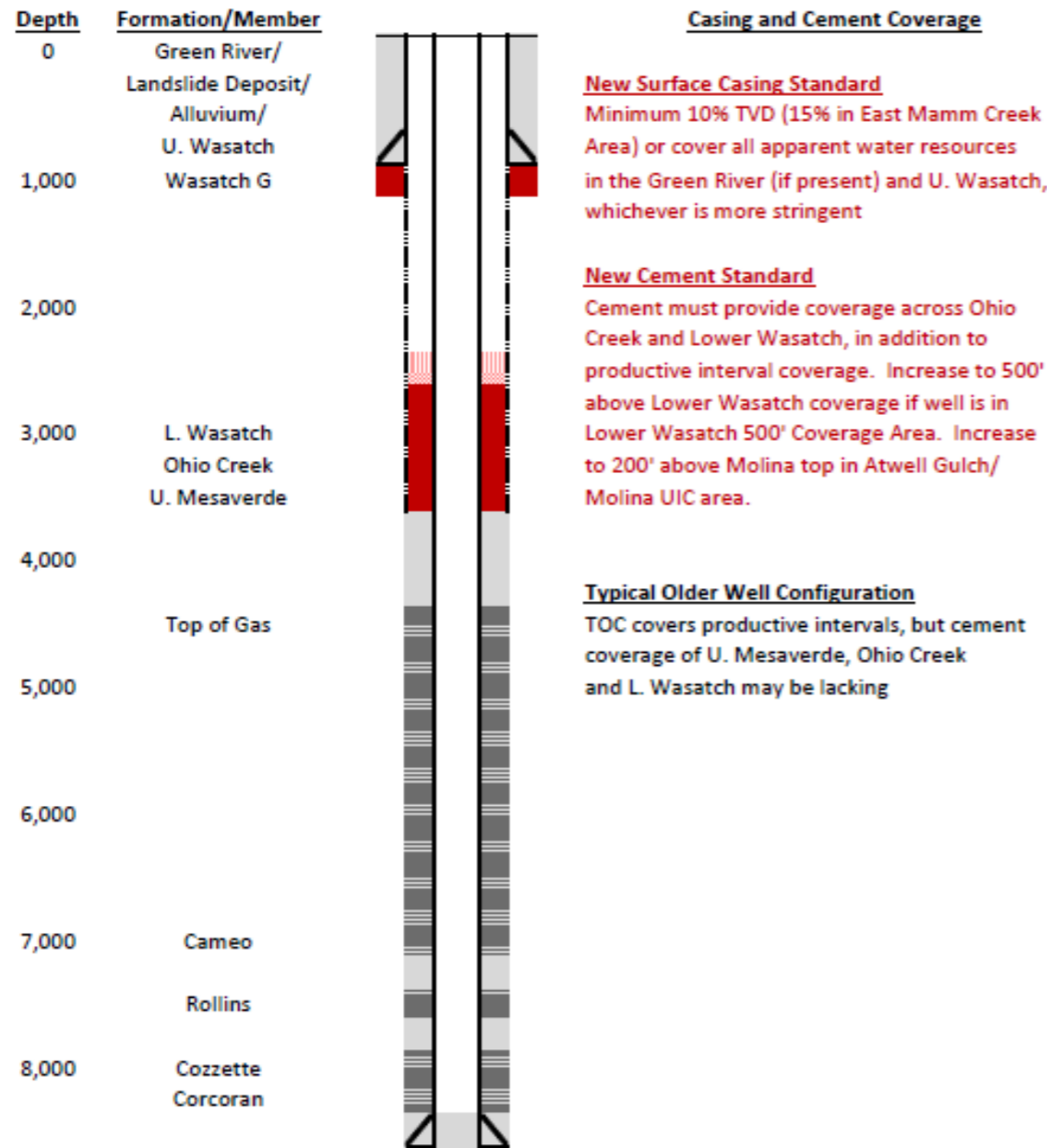
Hydrogen Sulfide: Detectable concentration reported in T7S, R93W (Section 12), during blowdown of a former UIC disposal well prior to plugging and abandonment of the well.

Mamm Creek Field Isolation WBDs

FIELD NAME MAMM CREEK
FIELD NUMBER 52500

LOCATION
Basin Piceance
Township(s) 5S to 8S
Range(s) 91W to 93W

Note: Depths to formation tops differ significantly with changes of ground surface elevation and geologic structure across the field. Refer to the Stratigraphy chart on the Field Scout Card. These wellbore diagrams reflect average depths in a small portion of the field. Also refer to standards in adjacent fields for guidance.





Commissioner *Q&A*



COLORADO
Department of Natural Resources