MARCELLUS SHALE COALITION™

RECOMMENDED PRACTICES:
Pre-Drill Water Supply Surveys

MSC RP 2012-3 August 28, 2012, Updated November 16, 2018

RECOMMENDED PRACTICES:
Pre-Drill Water Supply Surveys

1.1 Purpose

These recommended practices address relevant considerations and guidelines for Pre-Drill Water Supply Surveys and support the Marcellus Shale Coalition's (MSC) guiding principles. For the purposes of this document a water supply is defined as any water source such as a groundwater well, spring, pond, stream, or lake used for human consumption, or for agricultural, commercial, industrial, or other legitimate beneficial uses.

2.1 General

The objective of a Pre-Drill Water Supply Survey and associated water sampling is to establish a baseline for conditions that exist prior to oil or gas drilling activities. Groundwater typically contains various natural constituents not associated with human activity. The presence and concentration of any constituent may vary over time due to many factors such as water usage, meteorological events, seismic events, temperature, and barometric pressure changes. For example, there are areas throughout the United States where naturally occurring methane gas is present in aquifers frequently used as water supplies for private land owners. This has been well documented for decades in portions of the Appalachian basin (refer to the MSC's Recommended Practice for Responding to Stray Gas Incidents for further information on this subject). Therefore, it is important for both the operator and the water supply owner to understand the concentrations of constituents in, and other characteristics associated with, water supplies located in the area of planned drilling activities.

A Pre-Drill Water Supply Survey and associated water sampling should be conducted on all identified water supplies within a given area of the well pad surface location. The State Regulatory Agency (SRA) may have guidelines or regulations regarding the sampling distances. An oil and gas company may choose to sample beyond the area specified by the SRA, in accordance with the oil and gas company's internal sampling protocols. Sampling decisions may be based on hydrology, geology, aquifer characteristics or any number of other factors. Water supplies such as wells, springs, and ponds should be evaluated. Consideration should also be given to sampling water supplies that are not currently in use, as they could be put into use in the future.

Sampling and laboratory analyses should be conducted prior to any earth disturbance for site construction or drilling related activities. Consider performing another round of sampling and analysis prior to additional drilling related activities if significant time elapses (for example 6 to 12 months or more) between these activities. All communications with respect to authorization to access and sample the water supply(ies) for a property must be with the property owner.

3. 1 Initial Survey

Water supplies within the selected area of the well pad surface location should be identified during initial water supply inventorying activities or subsequent surveys. The following tools may be utilized to identify water well, pond, and spring locations: regulatory databases; topographic and aerial maps; windshield surveys; and property tax rolls. Each water supply should be given a unique identifier.

The owner and/or user (*e.g.,* resident or tenant) of the water supply should then be contacted to schedule the initial survey using, at minimum, any methods that may be prescribed by the SRA (*e.g.,* certified mail, direct contact). Operators should inform the water supply owners and/or residents that any and all information/data collected will be provided to the owner/ occupant and to the SRA (if required by state regulations) and, as such, the information could be disclosed as public information upon inquiry to the SRA.

With the assistance of the water supply owner or resident, locate the water supply(ies) and sampling location(s). Use GPS (preferably NAD83 datum) to determine and record the latitude and longitude of each water supply. For each water supply, conduct a survey or interview with the water supply owner or resident and document available basic water supply information (*e.g.,* if the supply is a water well obtain the depth, year drilled, casing type, treatment, historical water quality issues). Prepare a plan view sketch to document the location of the water supply (and sampling point), residence, septic system, adjacent surface water bodies, mine influenced water seeps and any other pertinent features. Photograph all notable features, such as the wellhead, spring location, sample point, etc. Note the approximate distances between features on the sketch. For informational purposes, Appendix A contains an example site visit form to help illustrate information that should be collected during each sampling event.

4. 1 Water Sampling

Water samples should be obtained by a properly trained and experienced independent third party. The sampling should be performed in accordance with any applicable state and federal regulations and requirements, and in accordance with all appropriate sample collection, preservation, handling, and chain-of-custody procedures. For more information, please refer to the MSC's Pre-Drill Water Supply Sampling Fact Sheet (http://marcelluscoalition.org/wp-content/uploads/2013/03/predrill_water_sampling.pdf).

Sampling should be conducted as close to the water supply source as is practical, and when possible, prior to any treatment system or storage tank. Whenever the sample cannot be collected prior to the treatment system/storage tank, the sampler should note this as part of the sample collection documentation.

If the property owner refuses to allow the operator access to conduct the water sampling, the operator should send a refusal notice to the water supply owner confirming that access was refused. The refusal notice should include the following:

- The operator's intention to drill or alter an oil or gas well.
- The desire to conduct a Pre-Drill Water Supply Survey.
- The name of the person who requested and was refused access to conduct the survey and sampling, and the date of the request and refusal.
- The operator should note that the presumption established under Title 58 (Oil and Gas) of the Pennsylvania Consolidated Statutes Section 3218(c) of Act 13 may be void if access to conduct the Pre-Drilling or Pre-alteration Survey is withheld.
- The name and address of the well operator, and the address of the SRA if required, to which the water supply owner or resident may respond.
- The operator should extend a final offer to sample.

The SRA may require a copy of this refusal notice as well. In addition, if a tenant at the property (not the owner) refuses access/sampling, the property owner should be notified regarding the attempt to assist in resolving access.

4.2 Sample Analyses

Water samples should be analyzed by an SRA certified laboratory using appropriate analytical methods (such as relevant EPA methods, ASTM methods, or methods listed in Standard Methods for the Examination of Water and Wastewater). For parameters that have a primary or secondary Maximum Contaminant Level (MCL) for public water systems, the laboratory should be instructed to provide a laboratory reporting limit no greater than the published MCL. The following parameters should be considered:

4.3 Parameters

Alkalinity	Xylene
Ethylene Glycol	Aluminum
pH (field and/or lab)	Arsenic
Specific Conductance	Barium
Total Dissolved Solids	Boron
Total Suspended Solids	Calcium
Chloride	Chromium
Sulfate	Copper
Bromide	Lead
Hardness	Lithium
Nitrate as N	Iron
MBAS/ Surfactants	Magnesium
Turbidity**	Manganese
Dissolved Methane*	Potassium
Dissolved Ethane	Selenium
Dissolved Propane	Sodium
Benzene	Strontium
Toluene	Vanadium
Ethylbenzene	Zinc

* Consider obtaining isotopic analysis if the Pre-Drill samples show levels of methane in a water supply that exceed background levels in the area.

** If Turbidity exceeds 10 NTU, the operator should consider collecting samples for dissolved metals analysis.

Additional parameters may be appropriate based on location and specific conditions and may be added at the discretion of the operator. Appendix B provides the list of parameters along with their respective MCLs (for those parameters that have an MCL). The USEPA primary and secondary MCLs have been established for treated drinking water at the delivery point of public water systems. Although MCLs are commonly used as a benchmark for private water supplies, it should be noted that the USEPA and the SRAs do not have authority to regulate private drinking water wells.

4.4 Reporting

A report documenting the Pre-Drill Water Supply Survey and associated analytical results of the predrill sampling should be prepared. The report should be provided to the water supply owner and where required, to the SRA. Additionally, some SRAs may have a required regulatory reporting deadline that must be met. In the case where a tenant resides at the property (not the owner), the owner should be advised that the results should be shared with said tenant(s). The report should contain the following information:

- The location of the water supply and the name of the water supply owner.
- The date of the survey, the name of the certified laboratory and the person who conducted the survey.
- A description of where and how the sample was collected.
- A description of the type and age, if known, of the water supply, and treatment, if any.
- The name of the oil or gas well operator, name and number of well(s) to be drilled and permit number(s) if known.
- The results of the laboratory analysis.

Consider including references that the water supply owner and/or resident may use to interpret the analytical data such as publicly available guidance documents from regulatory agencies. For more information, please refer to the MSC's Tips on Understanding Your Water Test Results http://marcelluscoalition.org/wp-content/uploads/2013/05/Tips-on-Understanding-Your-Water-Test-Results.pdf.

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APPENDIX A

SITE VISIT FORM

ONE FORM FOR EACH WATER SOURCE

Part A: GENERAL INFORMATION

Water Source ID:	**O&G Well Name/No.:**	**Permit No.:**	**Well Operator:**
Coordinates: (in NAD83, in decimal degrees)	**Lat** _____	**Long** _____	**Elevation** _____ **FT.**
Sampled By:	**Date Sampled:**	☐ **N/A: No Sample (See Notes)**	
Person Interviewed: ☐ **Owner** ☐ **Resident** ☐ **Tenant** ☐ **Executor** ☐ **Designee** ☐ **Neighbor** ☐ **Relative** ☐ **Trustee**			
☐ **Other (relationship to owner):** _____ *(attach documentation of authorization)*			

PROPERTY OWNER	**RESIDENT OR OTHER**
Name:	**Name:**
Address:	**Address:**
Address:	**Address:**
Phone No.:	**Phone No.:**

Part B: WATER QUALITY

	Owner/Tenant Reported Quality			**Survey Technician Observed Quality**		
	Yes	**No**	**N/A**	**Yes**	**No**	**N/A**
Staining	☐	☐	☐	☐	☐	☐
Odor	☐	☐	☐	☐	☐	☐
Cloudiness	☐	☐	☐	☐	☐	☐
Sheen	☐	☐	☐	☐	☐	☐
Effervescence	☐	☐	☐	☐	☐	☐
Taste	☐	☐	☐	**N/A**	**N/A**	**N/A**
				Color _____		

Have there been any water quality complaints previously filed for this water supply? ☐ **Yes** ☐ **No**

If yes what was the nature and date of the complaint? _____

_____

Part C: WATER SYSTEM HARDWARE

Treatment	**Pump Type**
☐ **None** ☐ **UV Light**	☐ **None**
☐ **Softening** ☐ **pH Adjustment**	☐ **Gas Piston**
☐ **Chlorination** ☐ **Other:** _____	☐ **Submersible**
☐ **Iron Removal**	☐ **Windmill**
☐ **In-line Sediment Filter**	☐ **Jet**
☐ **Charcoal Filter**	☐ **Other:**_____ _____
☐ **Reverse Osmosis**	☐ **Capacity** _____ **GPM**
Yes ☐ **No** ☐ **Functioning Properly**	**Size of pump (horsepower):**_____
Last date of maintenance: _____	

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Part D: WATER SOURCE INFORMATION

Does this water source supply any other properties? _____ If yes, identify properties _____

Is the water source(s) located on the property: Yes ☐ No ☐ If No, please explain:

Number of people using this water source? _____ Gallons/day, if metered: _____

Has water source ever gone dry? Yes ☐ No ☐

If so under what circumstances has it gone dry:

How frequently does it go dry:_____

Pressure Tank Yes ☐ No ☐ Size of tank _____ gallons ☐ Actual size ☐ Estimated ☐ Unknown

Water Use ☐ Domestic ☐ Husbandry ☐ Irrigation ☐ Other: _____

Water source uses: ☐ Drinking water ☐ Cooking ☐ Showering ☐ Laundry ☐ Dishwashing ☐ lawn care ☐ gardening

☐ Farm irrigation – How many acres?_____

☐ Animal husbandry – if cattle (how many head?)_____

Compass course from water source to dwelling _____ Estimated distance from water source to dwelling _____ FT.

Are there any other water sources on the property? Yes ☐ No ☐ If yes, how many?_____

Provide all water source ID(s) _____

Are you aware of any abandoned water source (s) on the property?_____ If yes, where_____,

when _____

Are you aware of any inactive (not currently used) water source (s) on the property?_____ If yes, where_____,

when _____

Water Source Type: ☐ **Water Well**

Driven Well: ☐ Drilled Well: ☐ Dug Well: ☐ Artesian: ☐

Other: _____

Reported total well depth: _____ FT. Well casing diameter:_____IN. Missing/damaged pit-less adaptor Yes ☐ No ☐ Unknown ☐

Depth to water: _____ FT. Reported pump depth _____ FT.

Measured: ☐ _____ FT. Reported: ☐ _____ FT.

If measured what was the method of measurement:_____

Combustible Gas Reading of Well Headspace:_____

Date Drilled: _____ Drilling Company:_____

Is the well located inside the house ☐ or outside the house ☐ Where is the well located (e.g., cellar, in the middle of the driveway, crawl-space, in the middle of the back yard)?_____

Is a driller log available for the subject water well? Yes ☐ No ☐ If yes please attach a copy.

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Driller's name _____

Depth of casing:_____ feet__ Open hole in bedrock: Yes ☐ No ☐ Screened in overburden:_ Yes ☐ No ☐

Signature of owner authorizing release of well log(s) _____

Is the landowner aware of any water quality complaint reported for the subject property? Yes ☐ No ☐

Was the subject water supply involved? Yes ☐ No ☐

Water Source Type: ☐ Spring

Discharge Pipe Yes ☐ No ☐ Seep/Ground Surface Flow Yes ☐ No ☐ Spring House Yes ☐ No ☐ Underground Vault Yes ☐ No ☐

PART D: DESCRIPTION OF WATER SOURCE (check all that apply)

- ☐ Water source open to the environment
- ☐ Water source open to surface water
- ☐ Source buried
- ☐ Cover flush with ground
- ☐ Water source covered and secured
- ☐ Loose, missing, or damaged cover (circle one if applicable)
- ☐ Evidence of insects, spiders, animals (circle one if applicable)
- ☐ Any cracked or damaged well casing/spring vault (circle one if applicable)
- ☐ Additional storage or holding tank/coyote system (circle one if applicable)
- ☐ Evidence of erosion of surrounding landscape
- ☐ Location unknown
- ☐ Other: _____

PART E: DESCRIPTION OF AREA SURROUNDING WATER SOURCE (check all that apply) Show locations on site sketch and provide approximate distance & compass course. Document housekeeping conditions. Information to be gathered through technician observation or landowner interview (Attach photos.)

- ☐ Ground sloping toward water source.
- ☐ Water source down-slope of septic system (approximate distance in feet.)_____
- ☐ Signs of failing septic, soggy ground, foul odor (circle all that apply and approximate distance in feet.)_____

Close Proximity to: (check all that apply, list approximate distance and compass direction)

√	Item	~feet	√	Item	~feet	√	Item	~feet	√	Item	~feet
✔	*Example*	*15 SE*	□	Garden		□	Agricultural field		□	Orchard	
□	**Greenhouse**		□	**Junk yard**		□	**Dumping area**		□	**Landfill**	
□	**Field with livestock**		□	**Barn**		□	**Barnyard**		□	**Other outbuilding**	
□	**Equipment storage**		□	**Maintenance areas**		□	**Garage**		□	**Pipeline**	
□	**Current mining activities**		□	**Historic mining activities**		□	**Salt storage area**		□	**Salted roadway**	

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□	Fuel storage tanks? Are tanks:		□	AST(s)		□	UST(s)				
□	Industrial Land Use		List type of use:							
□	Other:									

ADDITIONAL REMARKS & COMMENTS:

PART F: SAMPLING

SAMPLED	SAMPLING POINT LOCATION (be specific with regard to location of sample)
☐ Before Treatment ☐ After Treatment ☐ No Treatment ☐ Not Sure Average amount of water used within last 24 hours: _____	☐ Inside Faucet with aerator (e.g., kitchen, bathroom, etc.): _____ ☐ Inside Faucet without aerator (e.g., kitchen, bathroom, etc.): _____ ☐ Pressure Tank ☐ Overflow/Discharge Pipe ☐ Outside Faucet: _____ ☐ Wellhead ☐ Seep ☐ Spring ☐ Surface Water (sampled at coordinates in Part A) ☐ Other: _____

Please provide sampling point coordinates only if the sample point location is different from the water source location in Part A:

Sampling point coordinate: (in NAD83, in decimal degrees) Lat. _____, Long _____, Elevation _____ FT.

SAMPLING EQUIPMENT: ☐ Existing well pump ☐ Sampling pump ☐ Bailer ☐ Other: _____

PURGING METHOD (as applicable):

Was the water source purged before sampling? Yes☐ No ☐ If yes, volume purged (gal.) _____time purged(min) purged_____

rate purged: _____

Purging method: ☐ Low flow ☐ Volume Method ☐ Timed

FIELD ANALYSES:

Test	Measurement	Units
Turbidity		
pH		
Conductivity		

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Temperature		
ORP		
Other		

Combustible Gas Reading (Describe location and method):

Notes:

Chain of custody attached? ☐ **Yes** ☐ **No** **Name of Certified Laboratory:** _____

PART G: PLAN SKETCH and PHOTOGRAPHS *(use additional pages as necessary)* Show **compass course and provide approximate distance.**

Sampler/Interviewer

Sign _____ **Print** _____ **Date** _____

Company Name: _____

Appendix B

Summary of Aqueous Pre-Drill Constituents, Maximum Concentration Limits, Analytical Methods, and Holding Times

Constituent	MCL[1] (mg/L[2,3])	Required Laboratory Reporting Units	EPA Methods for Water Analysis[4]	EPA Waste: SW-846[4]	Standard Methods for the Examination of Water and Wastewater, 23rd Edition[4]	Other	Holding Times (with proper preservative)
Conventional Analyses							
Alkalinity	--	mg/L	--	--	2320B		14 days
Ethylene Glycol	--	mg/L	--	8015 Modified	--		14 days
pH (field and/or lab)	6.5-8.5 SU [5]	SU	150.1, 150.2	9040, 9041	4500-H+-B		Immediately (15 minutes)
Specific Conductance	--	uhmos/cm	120.1	9050	2510B		28 days
Total Dissolved Solids	500 [5]	mg/L	--	--	2540C		7 days
Total Suspended Solids	--	mg/L	--	--	2540D		7 days
Chloride	250 [5]	mg/L	300.0, 300.1	9056, 9212, 9250, 9251, 9253	4110B, 4500Cl-B,C,D,E		28 days
Sulfate	250 [5]	mg/L	300.0, 300.1	9035, 9036, 9038, 9056	4110B, 4500-SO42 Cor D		28 days
Bromide	--	mg/L	300.0, 300.1	9056	4110B		28 days
Hardness	--	mg/L	130.1, 130.2, 200.7 (calc)	6010 (calc)	2340 B or C		6 months
Nitrate as N	10	mg/L	300.0, 300.1, 352.1	9056, 9210	4110B, 4500-NO3 B		48 hours
MBAS/ Surfactants	0.05 [5]	mg/L	--	--	5540C		48 hours
Turbidity	--	NTU	180.1	--	2130B		48 hours
Dissolved Gases							
Dissolved Methane	--	ug/L	--	--	--	RSK SOP-175, PA-DEP 3686, ASTM D8028-17	14 days
Dissolved Ethane	--	ug/L	--	--	--	RSK SOP-175, PA-DEP 3686, ASTM D8028-17	14 days
Dissolved Propane	--	ug/L	--	--	--	RSK SOP-175, PA-DEP 3686, ASTM D8028-17	14 days
Volatile Organic Compounds							
Benzene	0.005	ug/L	624.1	8260, 8261	--		14 days
Toluene	1	ug/L	624.1	8260, 8261	--		14 days
Ethylbenzene	0.7	ug/L	624.1	8260, 8261	--		14 days
Xylene	10	ug/L	624.1	8260, 8261	--		14 days
Total Metals							
Aluminum	0.2 [5]	mg/L	200.7, 200.8	6010, 6020	--		6 months
Arsenic	0.01	mg/L	200.7, 200.8	6010, 6020	3113, 3114		6 months
Barium	2	mg/L	200.7, 200.8	6010, 6020	3111, 3113, 3120		6 months
Boron	--	mg/L	200.7, 200.8	6010, 6020	--		6 months
Calcium	--	mg/L	200.7, 200.8	6010, 6020	3111, 3120, 3500		6 months
Chromium	0.1	mg/L	200.7, 200.8	6010, 6020	3113, 3120		6 months
Copper	1	mg/L	200.7, 200.8	6010, 6020	--		6 months
Lead	0.015 [6]	mg/L	200.7, 200.8	6010, 6020	3113		6 months
Lithium	--	mg/L	200.7, 200.8	6010, 6020	--		6 months
Iron	0.3 [5]	mg/L	200.7, 200.8	6010, 6020	3111, 3113, 3120		6 months
Magnesium	--	mg/L	200.7, 200.8	6010, 6020	3111, 3120, 3500		6 months

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Summary of Aqueous Pre-Drill Constituents, Maximum Concentration Limits, Analytical Methods, and Holding Times

Manganese	0.05 [5]	mg/L	200.7, 200.8	6010, 6020	3111, 3113, 3120		6 months
Potassium	--	mg/L	200.7, 200.8	6010, 6020	--		6 months
Selenium	0.05	mg/L	200.7, 200.8	6010, 6020	3111, 3113		6 months
Sodium	--	mg/L	200.7, 200.8	6010, 6020	3111		6 months
Strontium	--	mg/L	200.7, 200.8	6010, 6020	3111		6 months
Vanadium	--	mg/L	200.7, 200.8	6010, 6020	--		6 months
Zinc	5 [5]	mg/L	200.7, 200.8	6010, 6020	--		6 months

Notes:

-- Not Defined
The laboratory reporting limits should be equal to or less than the MCLs.
1 - MCL - Maximum Contaminant Level - The maximum permissible level of a contaminant in drinking water which is delivered to any user of a public water system.
2 - Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.
3 - The US EPA regulates public water systems, it does not have the authority to regulate private drinking water wells.
4 - The analytical laboratory should use the most current analytical methods.
5 - Limit is a secondary drinking water standard. Secondary drinking water standards are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.
6 - Lead is regulated by a Treatment Technique that requires a system to control the corrosiveness of its water. This limit is an action level.

References:

Approved Clean Water Act - Chemical Test Methods
The analytical methods promulgated under Clean Water Act section 304(h) are sometimes referred to as the "304(h)" or "Part 136" methods.
The methods measure chemical and biological pollutants in media, such as wastewater, ambient water, sediment, and biosolids (sewage sludge). These various CWA methods are tested in a variety of labs and matrices.

SW-846
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015).

Standard Methods
Standard Methods for the Examination of Water and Wastewater. Standard Methods is a joint publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF), 23rd edition, 2017, E.W. RICE, R.B. BAIRD, A.D. EATON, EDITORS.

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