The Connection
A Well Drilling Industry Newsletter

VOLUME 21 NUMBER 2 MISSOURI DEPARTMENT OF NATURAL RESOURCES SECOND QUARTER 2014

Rule Updates

Six Missouri Well Construction Rule amendments are moving through the rulemaking process. Draft rules, if completed, are available on the department's Web page at dnr.mo.gov/geology/geosrv/geo-rules-in-dev.htm.

The draft language for the **Disciplinary Action and Appeal Procedures** (10 CSR 23-1.075) approved by the Board at the November 2013 meeting was forwarded to the Interagency Review Committee in February 2014. The 30-day review and comment period ended March 27, 2014. At the next quarterly meeting on May 2, 2014, staff will present the draft rule, incorporating changes based on comments received, and ask for the board's approval to file with the Secretary of State's Office for publication in the *Missouri Register*. At that time, the formal public comment period will begin.

Staff began drafting rule language for **Special Area 2** (10 CSR 23-3.100(5)) after the November 2013 board meeting, with the intention to begin stakeholder meetings this spring. However, based on discussions and recent sampling issues, staff will be drafting rule language that may include expanding the Special Area 2 boundaries.

A stakeholder meeting regarding **Sensitive Area A** (10 CSR 23-3.100(1)) was held January 28, 2014, in Owensville. This area encompasses parts of Phelps, Franklin, Crawford, Gasconade, Cole, Osage and Maries counties. Those in attendance were not in favor of the proposed language; the consensus was to leave the rule as is to require 150 feet casing where Pennsylvanian-age strata is present. Based on comments received and further internal discussion, staff will look into other state's well construction requirements before bringing a draft to the board for its approval. Staff may conduct another stakeholder meeting in the area.

Staff drafted proposed language for **Types of Wells** (10 CSR 23-1.030) and held a stakeholder meeting in Jefferson City April 1, 2014. The draft includes the addition of charitable or benevolent organizations, a change to the language for wells drilled at petroleum distribution sites, combining the high yield well and high yield bedrock irrigation well and eliminating Grade A dairy well definition.

Staff drafted proposed language for **Location of Wells** (10 CSR 23-3.010) and held a stakeholder meeting in Jefferson City April 1, 2014. The proposed draft includes language to address setbacks from known contamination sources, concentrated animal feeding operations (CAFO) and others. Also, the revised language better defines waste landfills and lagoons.

Staff drafted proposed language for **General Protection of Groundwater Quality and Resources** (10 CSR 23-3.020) and held a stakeholder meeting in Jefferson City April 1, 2014. The proposed draft includes language to address water wells drilled in conjunction with an oil and/or gas operation, and general cleanup of the rule language.

Questions regarding these rulemakings or the rulemaking process should be directed to Sheri Fry or Kyle Rollins.

Well Installation Board News

The Well Installation Board held its quarterly meeting Monday, February 24, 2014, at 10 a.m., at the Country Club Hotel and Spa in Lake Ozark, in conjunction with the Missouri Water Well Association's annual convention. The board received program and section updates and also updates about the Special Area 2 Impact Area map and proposed rulemakings.

The next quarterly meeting is scheduled for Friday, May 2, 2014, at the Missouri Geological Survey, Mozarkite Conference Room, 111 Fairgrounds Road, Rolla. The August meeting will be held at 10 a.m., Friday, August 8, 2014, at the MoDOT Southeast District Office in Sikeston.

Driller Bi-monthly Report Change

Since 2006, staff with the Wellhead Protection section (WHP) compiled and mailed a bi-monthly report to all contractors who submitted records to WHP during the previous two month time period. However, because WHP has been offering online search via the Wellhead Online Services website for more than a year, this report has become unnecessary; therefore, the last bi-monthly report was mailed in January 2014.

This change will result in substantial savings to WHP through postage, paper and printing costs, as well as staff time to compile and mail the reports. The same information is available 24/7 by going to this website: dnr.mo.gov/mowells. Questions regarding the online system should be directed to 573-368-2165.

Procedural Changes and Web Enhancements

Please note the following recently implemented procedural changes and Web enhancements:

- The Wellhead Protection section continues to make more services and data available online. Wellhead Online Services may be accessed at dnr.mo.gov/mowells. At this website, anyone may search for contractors and well and pump records. Contractors may submit monitoring well certification and registration, reconstruction, water well certification and pump records, as well as renew operating and vehicle permits. Soon, online testing for a restricted permit will be available.
- Forms are now single sheets and no longer have carbon copies.
- Owner signatures are no longer required for well certification.
- A user fee is being assessed when payment is made by credit card or electronic check. This fee is imposed by the credit card company and does not go to the department.
- The Heat Pump Rule became effective January 1, 2014. Please keep in mind that full-length grout is required for any geothermal well that is greater than 200 feet in total depth. A variance is not required for wells drilled to depths of 500 feet or less. If a geothermal well is grouted using a series of five foot plugs, the total depth of the well must be 200 feet or less, and prenotification of the work is required. WHP must be notified no less than 48 hours prior to any work being performed. Prenotification may be made by calling 573-368-2165, emailing welldrillers@dnr.mo.gov, faxing 573-368-2317, submitting online dnr.mo.gov/forms/780-2167.htm or mailing WHP at P.O. Box 250, Rolla, MO 65402. Notification must include owner name and address, GPS location, date work is to begin, primary contractor name and permit number and drilling contractor name and permit number. The printable form is available at dnr.mo.gov/forms/780-2167-f.pdf.
- Direct expansion heat pump systems that use copper tubing and refrigerants will no longer be allowed, as of January 1, 2015.

Receive Updates on Rules and Section Services

Did you know you can sign up to receive updates regarding multiple topics related to the Wellhead Protection section? Our GovDelivery system allows website visitors to subscribe to information of specific interest to them. Red envelope icons are available on many of the department's Web pages identifying this service as being available. Individuals are able to create a personalized subscription list of content. When this content changes, such as rule updates, GovDelivery automatically sends email or text alerts informing subscribers. To get started, go to the Wellhead Protection section Web page located at dnr.mo.gov/geology/geosrv/wellhd/ and click on the red envelope, enter your email address or sign in via social media and choose the topics for which you would like to receive updates. In addition to topics related to wellhead protection, subscribers may select from numerous other topics. Questions regarding this feature should be directed to 573-368-2165.

Welcome Contractors

The following individuals are now part of the Missouri Department of Natural Resources' permitted contractor community:

Burns & McDonnell – Brian Kistner, David Horne
Conestoga-Rovers & Associates – Patrick Umphenour
Environmental Resources Management – Adrienne Boettcher, Gregory Moore
Environmental Works – Douglas Jones
MoDNR – Airin Haselwander
Southeast Irrigation – James Hampton

Welcome Apprentice Contractors

The following individuals are now part of the Missouri Department of Natural Resources' permitted apprentice contractor community:

Aqua Wells – Robert Martin
Bulldog Drilling – James Dittmaier Jr.
Cooper Drilling – Rickey J. Cooper
Environmental Works – Michael Johnson, Ryan Thurman, Vance Marlow
Flynn Drilling – Andy Ferguson, Brandon Cunningham, Nick Crawford, Jason LaRocca, Alex Pullum, Chris Coin, Adam Cattell
Gingerich Well & Pump – Dennis Chittick
Mike Woolsey & Sons Well Service – Brandon Childers
Miller Plumbing & Heating – Timothy Moeller
Roberts Environmental Drilling – Nathan Frischkorn
Schroepfer Well Drilling – Jack Dames

Farewell

The people addressed below are no longer permitted to operate as contractors according to the Water Well Drillers Act and Missouri Well Construction Regulations:

Bernt, Eric
Berry, Michael
Bird Brothers Plumbing, Heating & Well – Steven Bird
Carlson Drilling & Pump – William Carlson
Environ International Corp. – David Bronson
Lefty's Pump & Drilling – Robert Blankenship (Deceased)
Loop Tech International – Ralph Cadwallader
PSA – John (Mitch) Hughes
Ranney Coll Wells/Layne Heavy Civic – Andrew Smith
Rosebrough, Donald
Schnieders, Danny
Stoner Well Drilling – Bobby Stoner
Terracon – Craig Van Vactor
Thiele Geotech Inc. – Dennis Anderson
Tolbert, Andy
Vironex – T.J. Haley

Cement Bond Logging Equipment Purchased

To better evaluate the quality of well construction in Missouri, the Missouri Geological Survey purchased cement bond logging equipment. The equipment is used to analyze the annular grout seal integrity and its bond with steel casing. The package includes a full-waveform sonic tool that houses one transmitter and two receivers, a 500-meter winch, a processing console, and all supporting hardware and software. Upon delivery to Rolla, Wellhead Protection section staff members received hands-on training in cement bond logging and interpretation. The training included logging of the Survey's new test well at the McCracken Core Library and Research Center.

The experience was unique and valuable in that it allowed staff to compare the resulting cement bond log with the known construction specifications of the McCracken well. The new equipment performed satisfactorily and demonstrated its usefulness for conducting efficient field analysis of annular grout seal integrity.

The property of the sound waves emitted by the transmitter is a function of the density of the medium through which it travels. Therefore, the quality of the annular grout seal is determined by the way sound waves are transmitted through the casing, the cement, and the formation (Cement Bond Logs, 2013). To facilitate acoustic coupling, the full-waveform sonic tool must be completely submerged. A series of sonic pulses travel from the transmitter, through the wellbore fluid, and refract along the casing-cement interface and along the cement-formation interface back to the receivers (Crain, 2014). The amplitude of the signal attenuates when good cement bond is present, but it is sustained in partial bond or free pipe void of grout (Cement Bond Logs, 2014). The full-waveform sonic tool comprises one transmitter and two receivers located at three and four feet from the transmitter.

Compressional waves (P-waves) are used to measure the travel time from the transmitter to the receiver (Cement Bond Logs, 2013). The transmitter emits a series of sonic pulses while the near receiver is used to measure signal amplitude and the distant receiver is used to measure the entire waveform. Data collected from both receivers is used to determine travel time.

The signal picked up by the first receiver, TT3 (travel time 3-foot), is used to measure the quality of cement bond to the casing (Cement Bond Logs, 2013). If there is little to no bond, the amplitude of the signal will be very large, but if there is a good bond of cement to casing, the amplitude will be very small (Pekiner, 2014). This is the same as sound reverberating through a bell when it is struck. Sound is dampened if something is in contact with the body which will result in a dull thud. When nothing is in contact with the bell, sound will ring freely.

The signal received by the second receiver, TT4 (travel time 4-foot), is refracted from deeper in the formation and used to assess the cement to formation bond (Cement Bond Logs, 2013). The TT4 signal has a larger spacing and is sampled over the entire wavetrain. The first arrival and subsequent reverberations are recorded as the variable density log (VDL) signal. The VDL is a graphic depth vs time representation of waveform amplitude rendered in shades of black and white. Positive amplitudes are displayed as dark bands and negative amplitudes are displayed in white or shades of grey.

Cement bond logging equipment at the McCracken Core Library and Research Center.

High contrast bands indicate higher amplitude. Free pipe and borehole fluid arrivals produce straight dark and light lines at the ends of the display. The wavy pattern between the free pipe and fluid arrivals is the formation signal. A straight "bumblebee" pattern indicates that there is no cement bond.

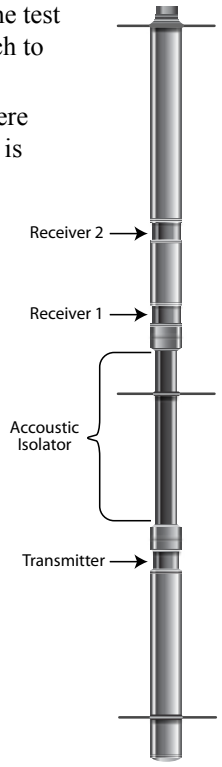
These waveform characteristics were observed firsthand while logging a specially constructed well at the McCracken Core Library and Research Center. The well was built for the purpose of examining what effects different grout seal materials have on the transmission of sonic vibrations. The annular space in the 200-foot well was grouted with neat cement using two different installation methods. The lower 126 feet was pressure grouted and the upper 32 feet was poured in. To separate the two cement intervals, 42 feet of pea gravel was placed in the annulus.

The varying grout seal characteristics in the test well provided a good environment in which to test the bond logger.

The cement bond log clearly indicates where the pipe is well cemented and where there is unbonded pipe.

The first-arrival amplitude and the VDL recorded by the bond log equipment indicated three discrete intervals of grout material in the test well. The cement intervals produced a low-amplitude first arrival signal and wavy VDL, while the pea gravel interval produced a high-amplitude first arrival with a distinct high amplitude "bumblebee" pattern on the VDL.

By using the McCracken well as a training platform, staff members were able to see firsthand how the new bond logging tool can be used to analyze the properties of material behind well casing. Until now, we have had no method of directly evaluating cement grout seal integrity.



Full-waveform sonic tool.

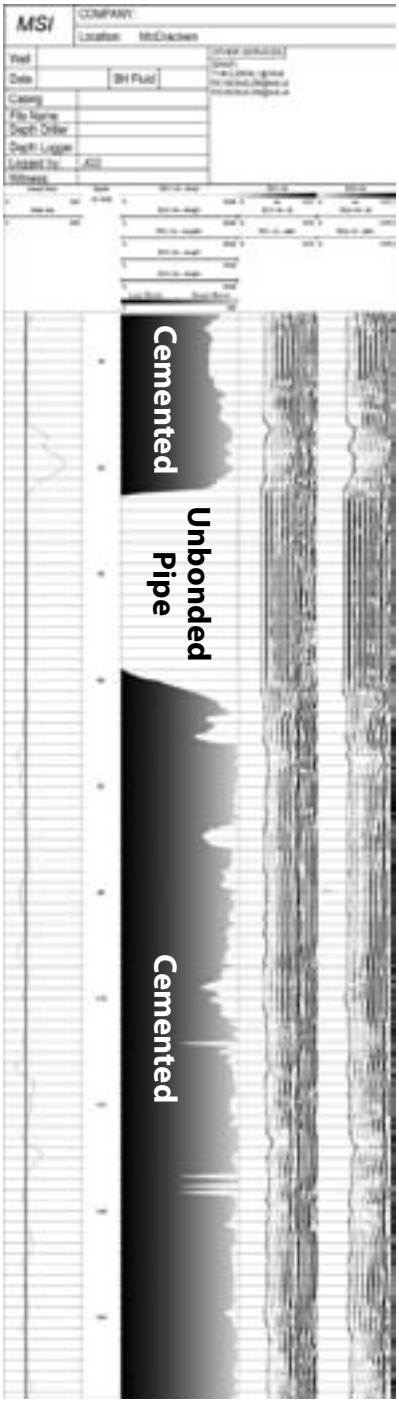
With the acquisition of the new equipment, the Wellhead Protection Section staff will be able to conduct detailed field analysis of cement bond quality beyond a more protracted dye trace analysis.

References

Cement Bond Logs. PetroWiki. SPE International, 14 Sep 2013. Web. 25 Feb 2014. <http://petrowiki.org/Cement_bond_logs>.

Crain, E.R. Cement Integrity Logs - Part 1 - CBL / VDL. Crains Petrophysical Handbook. N.p. Web. 25 Feb 2014. <http://spec2000.net/07-cementlog1.htm>.

Pekiner, Yalcin. Cement Bond Log CBL-VDL. Log Interpretation Center For Your Subsurface Exploration. Pekline LTD. Web. 25 Feb 2014. <http://www.bridge7.com/grand/log/gen/casedhole/cbl.htm>.



Cement bond log of the McCracken test well.

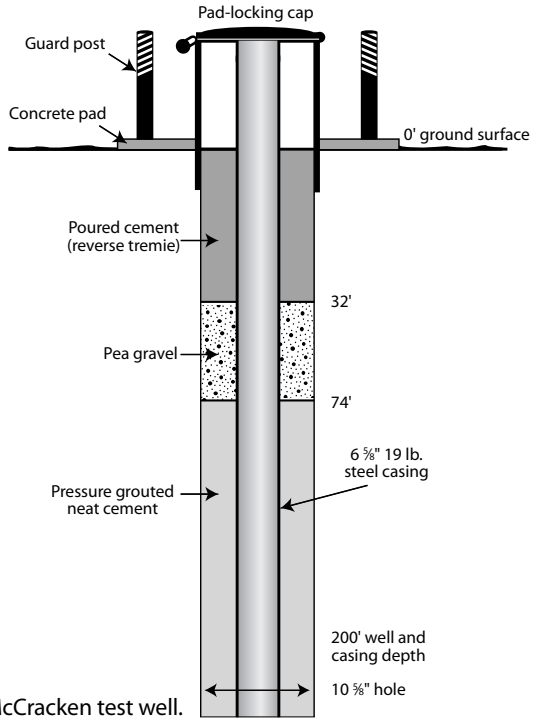


Diagram of the McCracken test well.

Roubidoux Formation Map Published

The Missouri Department of Natural Resources' Water Resources Center (WRC) recently released a new open-file map beneficial to the well drilling community. Structural Base of the Roubidoux Formation (OFM-12-613-WR) is a structure map contoured at the bottom of the Roubidoux Formation based on elevation above sea level. A structure contour map depicts lines of equal elevation and structures such as faults and folds in the subsurface. This map was contoured with data from more than 2,000 state-wide geologic well logs in areas where the Roubidoux Formation is expected to produce potable water.

The Roubidoux Formation, typically a sandy or cherty dolomite, is a common casing or production target for both public water supply and private wells. It crops out at the surface near the St. Francois Mountains and is present in the subsurface across most of the state. The Roubidoux Formation increases in depth away from the St. Francois Mountains, reaching a depth greater than 4,000 feet in southern Dunklin County. Numerous faults and geologic structures have resulted in dramatically different depths to this formation over a small distance, often making its location in a well difficult to predict.

This new map can be used by well drillers and engineers to determine the approximate elevation of the bottom of the Roubidoux Formation at a proposed well site. This elevation can be subtracted from the surface elevation to give a reasonable approximation of the depth at which a well will fully penetrate the Roubidoux Formation. This knowledge enables drillers, engineers, and resource planners to more accurately develop work plans that target this groundwater resource.

A digital version of this map may be viewed on the WRC website at dnr.mo.gov/env/wrc/. A printed version may be ordered from the Missouri Geological Survey through its online store at missourigeologystore.com or by calling 573-368-2125.

The next map planned in this series is a contour map of the top of the Potosi Dolomite, the basal formation of the Ozark Aquifer, with a contour map of the base of the Gunter Sandstone Member of the Gasconade Dolomite to follow. Questions about this map or mapping process can be directed to Kurt Hollman, WRC, at 573-368-2188 or kurt.hollman@dnr.mo.gov.

Staff News

Airin Haselwander Joins the Section

Airin Haselwander accepted a full-time position as a geologist with the Wellhead Protection section, effective January 16, 2014. Airin graduated from Missouri University of Science and Technology with a Bachelor of Science in Geology. Airin's prior experience with the Missouri Geological Survey was in the Geologic Mapping section developing maps depicting potential geologic hazards. Airin's new duties include reviewing and certifying public water systems and pilot holes, performing well searches, and issuing casing depths and variances. "I am excited to be working for Wellhead Protection. I know there are a lot of new things to learn, and I am eager to begin a new chapter in my career. I look forward to working with the drilling industry and my new co-workers," Airin said.

Marissa Spencer Joins the Section

Marissa Spencer accepted a full-time position as a Senior Office Support Assistant with Wellhead Protection section's Processing unit, effective March 5, 2014. Marissa previously held positions with Missouri State Parks at Onondaga Cave State Park as an interpretative resource specialist, and with the Missouri Geological Survey as a student intern. She has gained valuable experience during the last few years working on various projects in Geologic Resources section's Energy Resources unit, and for the last few months in the Wellhead Protection section. Marissa plans to complete a Bachelor of Science degree in Geology and Geophysics from the Missouri University of Science and Technology this summer and continue her education there pursuing a graduate degree. "I am looking forward to serving the public in Wellhead Protection and feel fortunate to work with such welcoming and dedicated professionals," Marissa said.

Permits and Vehicles Renewable Online

For your convenience, permit and vehicle cards may be renewed online by going to dnr.mo.gov/mowells and selecting the "Renew Permits" option. This option is available only for those who have no changes (address, phone number, permit type, etc.) that need to be made on their permit, provided no outstanding violations exist. Within 60 days before or 30 days after the renewal date, contractors can pay for permits, vehicle cards and late fees that have been assessed. Contractors must print their permit and vehicle cards before leaving the web site, because it is not possible to return to the site to print cards after leaving the site. Questions should be addressed to Sheri Fry or Jeannie Hoyle.

Contractor and Apprentice Well and Pump Installation Testing Schedule

All tests begin at 9 a.m.

The following testing dates are scheduled at the Missouri Geological Survey, 111 Fairgrounds Road, Rolla.

May 14, 2014	September 17, 2014
June 18, 2014	October 15, 2014
July 16, 2014	November 19, 2014
August 13, 2014	December 17, 2014

Testing dates may be modified if necessary.

Please bring a picture ID with you to the testing site.

If you are applying for a non restricted permit, please be sure to bring your global positioning unit (GPS) and operating manual to the test site. Your GPS unit should be programmed to read in degrees, minutes, and seconds in accordance with 10 CSR 23-3.060(5).

If you have questions concerning this schedule or testing please call 573-368-2450. Persons with disabilities who may require special services may contact Jeannie Hoyle at the number above.

Wellhead Protection Section

We are here to ensure any new private well drilled in Missouri is constructed to minimum standards as set by state regulations. This helps protect our groundwater resources from contamination due to poor well construction. We regulate the construction of private water wells (this includes domestic and multiple family class wells), irrigation wells, monitoring wells and heat pump wells. In addition, we regulate how to properly plug all types of wells. Our job is to balance the concerns of the land owner and the driller, while at the same time performing our overall directive of protecting Missouri's vast underground water supply from contamination due to improper construction and abandonment of wells.

Important Documents Online

The Water Well Drillers Act may be found at this Missouri General Assembly website (see section 256.600): moga.mo.gov/statutes/c256.htm.

Well Construction Rules may be found at this Missouri Secretary of State website: sos.mo.gov/adrules/csr/current/10csr/10csr.asp#10-23.

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The Connection is published by the Missouri Department of Natural Resources' Missouri Geological Survey. Suggestions, ideas and comments concerning this newsletter are welcome. Send comments to: Missouri Department of Natural Resources' Missouri Geological Survey, Wellhead Protection Section, PO Box 250, Rolla, MO 65402-0250, phone: 573-368-2165 or fax: 573-368-2317.