



## **SAFETY OF CENTRALIZED LARGE PITS AND IMPOUNDMENTS USED IN THE DRILLING OF HORIZONTAL NATURAL GAS WELLS**

By the West Virginia Department of Environmental Protection's  
Office of Oil and Gas  
Pursuant to W. Va. Code §22-6A-23  
March 7, 2013

### **INTRODUCTION**

As directed by the Natural Gas Horizontal Well Control Act (the Act) enacted by the West Virginia Legislature on December 14, 2011, the following is in fulfillment of the mandate pursuant to W. Va. Code §22-6A-23 that the Department of Environmental Protection's (DEP) Office of Oil and Gas (OOG) report on the safety of centralized large pits and impoundments (W. Va. Code §22-6A-9) used in the drilling of horizontal natural gas wells that are not associated with a specific well work permit. The sampling, data analysis, and literature review comprising the study supporting this report were performed by staff of the West Virginia University's (WVU) Water Research Institute and the faculty and students of the Department of Civil and Environmental Engineering.

### **BACKGROUND**

One of the major concerns with the hydraulic fracturing process associated with horizontal drilling is that it requires large quantities of water. This water, along with any returned flowback and produced water, is then frequently stored in centralized large capacity pits and impoundments at or near the well location. To address the legislative mandate and these concerns, a study was conducted that focused on the structural integrity and safety of these large pits and impoundments. All three centralized pits constructed under the auspices of W. Va. Code §22-6A-9 during the short period of time between the passage of the Act and the deadline for the submission of study findings to the Legislature, were evaluated for safety and monitored for leakage. Groundwater monitoring wells were installed and sampled periodically around each of the three centralized pits. WVU also studied 12 large capacity pits and impoundments that existed prior to passage of the Act.<sup>1</sup> The OOG selected a broad spectrum of sites for the study,

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<sup>1</sup> Late in the sampling and data collection phase of this study, another large capacity pit being newly constructed was added to the study. Groundwater monitoring well sampling around this structure is underway, and will be documented reported separately. While not a centralized pit, the evaluation and sampling at this single-lined pit will provide data on newer structures associated with well work permits.

including pits and impoundments constructed using a variety of construction techniques. WVU developed a relative scoring mechanism to rate these sites in a consistent manner, while evaluating the construction, operation and maintenance of these pits and impoundments. Therefore, this study provides insights into the safety of large capacity pits and impoundments as they were constructed both before and after passage of the Act and implementation of current policy.

In addition to the safety of the structures themselves, the Legislature directed OOG to evaluate whether testing and special regulatory provision is needed for radioactivity or toxins held in the pits and impoundments. To that end, WVU sampled and analyzed the solids and liquids held in the structures to determine if it exhibited radioactivity or contained other constituents of concern. In particular, WVU sampled the returned flowback from the Marcellus Formation and cuttings from the shallower formations drilled (i.e. only from the vertical portion of the drilling process). While WVU provided a comparison of sampling results with drinking water standards as a way to prioritize potential health impacts, it is important to note that these process streams are not allowed to be discharged into surface waters. In fact, the OOG's regulatory framework provides for practices to prevent and minimize such environmental and human health exposure.

## CONCLUSIONS

Based on sample results of both the material held in the structures and the groundwater below them, the study showed that no leakage was detected from the examined structures. Further, sites designed and constructed to the current OOG standards scored higher (using WVU's relative scoring mechanism) than those built prior to the Act. Finally, the study showed that radiological exposure from material both on the well pads and at the centralized structures is within acceptable limits.<sup>2</sup> Thus, the structures subject to this study posed no imminent threat to public health or the environment. Therefore, OOG is able to conclude that the current regulatory framework is sufficient to properly regulate the construction, operation, and maintenance of large capacity pits and impoundments.

During the study, operators were not always complying with current rules and policies in both the construction and the operation/maintenance of the pits and impoundments. Problems included the placement of woody debris in the fill, improper compaction, surface erosion, slope movements, inadequately secured liners, bulges in liners, seepages and wet zones in embankments, small slips and cracks, standing water on berms, and debris on liners. Therefore, inspectors followed up with the subject operators to require corrective action.

Based on the study, the OOG provided additional training specific to the proper design, construction, and maintenance of large capacity pits and impoundments to agency personnel and

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<sup>2</sup> This study did not address the health effects of continued, long-term exposure of gas field workers to the radiation associated with the development of Devonian shale gas. WVU measured most samples they collected in activity rather than exposure. Those samples that were measured for exposure showed rates that were much lower than Occupational Safety and Health Administration (OSHA) standards and therefore safer. Of the samples measured for activity, WVU reported that some exceeded drinking water standards; however, since there is no route of exposure, drinking water standards are not applicable for comparison, as those standards assume that people are directly ingesting the material.

the regulated community. Continuous improvement through training has been, and will continue to be, ongoing at numerous events in order to stay apprised of the new and constantly changing industrial activities associated with horizontal well drilling. In addition, the OOG developed a standard inspection checklist to ensure that the inspection of pits and impoundments is standardized across the Office of Oil and Gas. The OOG will continue these endeavors to make certain that all parties involved in the construction, operation, maintenance, and regulation of these structures understand and are fully able to implement best construction and maintenance practices in order to minimize potential adverse impacts that may result from noncompliance. Further, additional revenues received, because of an increase in application fees in the Act, have allowed the OOG to hire additional inspectors to help ensure that operators adhere to current rules, policies, engineering standards, and best management practices during both construction and operation/maintenance of these structures. The OOG concurs with WVU that “future construction, if done in accordance with the WVDEP guidelines, should pose minimal risk.”

WVU has suggested numerous recommendations based on their field sampling results and literature review throughout the study reports. Many of the recommendations, while outside the specific scope of the legislative mandate of W. Va. Code §22-6A-23, are already addressed by the OOG’s existing regulatory framework. The OOG also has specific authority to condition the issuance of certificate of approvals and individual permits. This framework ensures adequate controls are in place for these large pits and impoundments (W. Va. Code §22-6A-9), and no greater monitoring, safety or design requirements or other specialized permit conditions are necessary at this time to effectively regulate the construction, operation, and maintenance of centralized large capacity pits and impoundments.<sup>3</sup>

## SUPPORTING INFORMATION

*Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations AGM 064, Project Overview: Water and Waste Stream Study & Pits and Impoundments Study*, West Virginia Water Research Institute, West Virginia University, February 15, 2013, submitted February 20, 2013. This document is an overview of the water quality, as well as pits and impoundment reports submitted to OOG to date.

*Pits and Impoundments Final Report for Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations (ETD-10 Project)*, John Quaranta, Ph.D., Richard Wise, Andrew Darnell, M.S.C.E, E.I.T. Department of Civil and Environmental Engineering, West Virginia University. December 17, 2012 (second version with this date), re-submitted February 15, 2013. This document addresses the structural integrity of the pits and impoundments.

*Final Report Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells Phase I for “Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations,”* Paul Ziemkiewicz, Ph.D., Director, Jennifer Hause, Brady Gutta, Jason Fillhart, Ben Mack,

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<sup>3</sup> The Rules Governing Horizontal Well Development (35CSR8), proposed for consideration during the 2013 legislative session, contains additional language detailing requirements associated with W. Va. Code §22-6A-9 structures.

Melissa O'Neal, West Virginia Water Research Institute, West Virginia University, February 15, 2013, submitted February 20, 2013. This document addresses groundwater, as well as the toxicity and radioactivity of the materials held by the pits and impoundments.

*Pit and Impoundment Evaluation and Sampling Plan For Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations (ETD-10 Project)*, John Quaranta, Richard Wise, Andrew Darnell, Michael Kulbacki, Matt Idleman, Justin Pentz, Department of Civil and Environmental Engineering, West Virginia University, December 10, 2012.

Memorandum: WVU Large Impoundment/Pit Study Recognition and Response by Office of Oil and Gas Personnel by David J. Belcher, December 3, 2012. This memorandum documents the follow-up inspections OOG performed on the studied structures after training its personnel.

Standardized impoundment and pit inspection checklist, November 8, 2012. This document ensures consistency when the structures are inspected by DEP's Office of Oil and Gas personnel.