Gas Well Study, 2013

The wellhead for 47-079-00748, a producing well in Putnam county, West Virginia, has nearly been buried by sediment. The heavily corroded casing head has several small leaks. Photo taken on 16 September 2013.

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Gas Well Study is the examination of natural gas wells in West Virginia.

Well sites are surveyed for compliance with state and federal regulations.

Well sites are also surveyed for environmental issues.

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Introduction

This year's report on our 2013 activities will have five areas of focus: the ten wells we've looked at; our second Gas Well Workshop conducted with the West Virginia chapter of the Sierra Club; the state's Underground Injection Control (UIC) class 2 program overseen by the Office of Oil and Gas; online materials created for the West Virginia chapter of the Sierra Club website (www.marcellus-wv.com) treating the issues surrounding Marcellus exploration and development in West Virginia; and, finally, our response to the Office's inspection report for wells we described in our *Gas Well Study, 2012*.[1]

Our year's effort was spent primarily on education. While we continue to look at wells, only five of the ten were new sites. Two of those wells were UIC class 2 wells we were only able to examine from outside the fences surrounding the facilities.

Photo 1. Tanks at 47-079-00746. The steel tank behind the large plastic tank has large holes. Containment dike has eroded on river side (left in photo) so that containment no longer is adequate. Photo taken on 16 October 2008.

Well Sites

Some of the sites we examined will have further discussion in other parts of this report. Two sites were visited as part of the field trip following the spring's Gas Well Workshop. One site was part of the field trip which followed the West Virginia chapter of the Sierra Club's third Marcellus Academy. Two sites were reexamined as part of our response to the Office's inspection report on wells we looked at in 2012. These sites had been previously visited in 2012 or earlier. Five new sites were examined in 2013. All but two of the ten sites looked at in 2013 were in Putnam county. The sites visited include an abandoned well and represent four active operators.

2013 Gas Well Workshop Field Trip

We looked at three sites (47-039-05714 is not described here) as part of the follow-up field trip for the West Virginia chapter of the Sierra Club's Gas Well Workshop. A similar field trip in the northern part of the state visited three horizontal Marcellus well sites.

The field trip had several purposes: introduce people to natural gas well sites; discuss issues related to hydraulic fracturing, waste management and site contamination; and involve participants in active examination of features of a site such as vegetation issues, secondary containment, and proper API number.

47-079-00746 is a well we previously visited in 2008/2009 and described in *Gas Well Study, 2009*.[2] An API number is present at this older well site. A large stack of rusty pipe lies next to the well head. There are two large 100 barrel tanks; the steel tank has holes and is not being used. Secondary containment is present around both tanks but the earth dike is so eroded at points that containment is not adequate.

47-079-00615 is an abandoned well. It was not producing when we visited in 2012, gas flow was audible in April 2013. There is no API number on the well and the tank has no secondary containment. During April's visit we tested soil and water samples at the site. We tested a water puddle away from the tank for chloride and took a soil sample from below the tank's leaking lower valve. The soil sample showed chloride at >641 ppm (the upper limit of our test method); the water sample showed no chloride. Chloride normally does not persist in soil and concentrations in soil are normally close to 0 ppm. We will return to this well in our response to the Office's inspection report (page 13).

[1] George Monk and Molly Schaffnit, 2013, *Gas Well Study, 2012* and associated web pages at http://www.sootypaws.net/gws/gaswell/comments/otherwells/2013/index.html.

[2] George Monk and Molly Schaffnit, 2010, *Gas Well Study, 2009*.

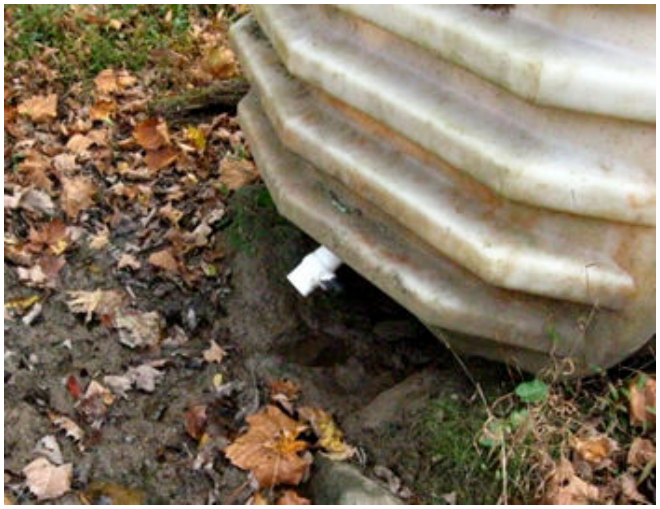

Photo 2. When we revisited 47-079-00615 in April 2013 we found the well producing. Fluid in the tank was slowly leaking from the valve at the bottom of the tank. The soil sample taken here had chloride at more than 641 ppm (the upper limit of our test method). Photo taken on 12 October 2012.

Photo 3. These two large storage tanks are at the edge of the Tall Trees pad in Upshur county (47-097-03707 and 47-097-03708 horizontal Marcellus wells). The containment would be adequate if it were not more than half full with standing water. Photo taken on 14 July 2013.

Tall Trees Site

We returned to the Tall Trees site in Upshur county (47-097-03707 and 47-097-03708) as the field trip for the third Marcellus Academy held in July. Beforehand we had a chance to study the permit for 47-097-03708, completion reports and plats for the wells and other documents.[3] Academy presentations with photographs showed the construction of the site, drilling of the wells, fracturing and final placement of site structures, reclamation, and pipeline construction. These visual aids and presence of Ms Cindy Rank and Mr Tim Higgins during the field trip helped shed light on both what existed before the wells were drilled and what exists now.

In 2012 we noted poor drainage control and use of the site access road as drainage from the site. We noted rills in the access roadway gravel in 2013. A new gate was found at the site entrance. Secondary containment was present for the large storage tanks, though it was partially filled with water. We were told that standing water in the containment was not uncommon.

Study of 47-097-03708's plat showed a major error for the location of the well. Data on the Office's Map Search and West Virginia Geological and Economic Survey's Pipeline databases show the well about 2.75 miles distant from the actual location.

This is due to how wells' locations were determined using measurements from the upper right hand corner of a USGS quad map. This system had led to errors.[4] Locally, we have found errors in locations for wells such as 47-039-02319.

The actual, precise, location for 47-097-03708 is UTM 17 556630.5E 4293991.9N.[5]

Putnam County Sites

We looked at three sites for the first time this year in Putnam county. One site is part of a cluster of sites near Camp Virgil Tate (see page 3 of *Gas Well Study, 2012*), two sites were in the Amherst Plymouth Wildlife Management Area.

[3] These documents are available online at http://www.sootypaws.net/gws/2013MA/index.html.

[4] Michael Shank, nd, *Well Location Accuracy Assessment, Kanawha State Forest*, Technical Applications and GIS Unit, West Virginia Department of Environmental Protection. The author found three (of 35) wells had an error of greater than 4,000 meters. Twelve wells had an error of more than 100 meters.

[5] The location is based on data found in Scientific Drilling, Inc.'s drilling report for 47-097-03708. The latitude is 38.792856 and the longitude is -80.347906.

Photo 4. There are several small leaks on the heavily corroded casing head for 47-079-00748. Standing water was bubbling. Photo taken on 16 September 2013.

Photo 5. Tank and separator for 47-079-01324. The tank does not have required secondary containment. Photo taken on 23 September 2013.

47-079-00748 is a poorly maintained older well site with a number of problems located northwest of wells near Camp Virgil Tate we looked at in 2012. The wellhead is in a low excavated area on the pad which we call the "basin." Because of severe site erosion the wellhead is almost completely buried in silt. The well's casing head had several leaks.

The API number is present nearby but just showed the last three digits. There is an extremely tall separator (similar to that noted at a Kanawha State Forest site in 2011).[6] The 100 barrel steel tank is in a heavily overgrown area. A dike is present but it wasn't possible to determine if it is adequate.

This well, like this operator's other wells, had no annual production reports filed for the years 2008, 2009, and 2010. The operator has filed production reports for their wells in 2011 and 2012.

The two Amherst Plymouth WMA wells were more recently drilled vertical shale wells and are part of a single operator's complex of wells in the WMA. This operator experimented with horizontal drilling here in 2005-2006, including a well with multiple horizontal laterals from a single vertical bore (47-079-01307). Google Earth views show a large number of sites with tanks without secondary containment and sites with major slips/erosion issues. We plan to examine more wells in the WMA in the future.

47-079-01286 is about three-quarters of a mile east of the WMA entrance off State Route 62. The site is well vegetated and has an extremely tall rock high wall. There is an API number for the well but the 2,100 gallon plastic tank doesn't have secondary containment. The access road spur is mostly gravel but is eroded and rutted on the steep slope. The portion of the main access road that we walked was well graveled and maintained.

47-079-01324 is about a half mile east of the WMA entrance off State Route 62. The pad is poorly vegetated and has a severely eroded fill slope. Bits of embedded pit liner were present but a test of standing water nearby showed low to no chloride. Water runs from the cut slope across the pad past the wellhead. We didn't have time to see if the fill slope's erosion impacts the stream below. The well has the correct API number but the steel 50 barrel tank is without secondary containment.

Both of these wells verified aerial evidence provided by Google Earth.

UIC Class 2 Wells

We looked at two UIC class 2 wells in 2013. One was next to Tupper's Creek (close to I-77) in Kanawha county and the other was in the Amherst Plymouth WMA. A description of the wells follows.

[6] George Monk and Molly Schaffnit, 2012, *Gas Well Study, 2011*, page 2. See also photos on our website at http://www.sootypaws.net/gws/gaswell/comments/otherwells/2012/ksf.html.

Photo 6. 26 March 2012 Google Earth image of 47-079-01324 in the Amherst Plymouth WMA. The large severely eroded fill slope takes up most of the left portion of the image. Google Earth imagery like this shows lack of secondary containment for tanks at wells in the WMA. Some sites like this have problems with slips and/or severe erosion.

Photo 7. The large tank at UIC class 2 well 47-039-02210 next to Tupper's Creek holds 57,000 gallons. It has a flammability warning posted. There is no visible secondary containment. The unloading pad is in the foreground. The yellow grid appears to be grates covering a sump. Photo taken on 6 April 2013.

For more information on the Office's UIC class 2 program see page 6.

The Tupper's Creek well (47-039-02210) is a commercial UIC class 2 well that has operated since the 1980s; the current operator has owned the well since 2008.

The site is well fenced with locked gates at the two site entrances. No signage was present providing operator's name, API/UIC well number, or emergency contact numbers.

The site has three tanks. One large 57,000 gallon tank has no visible secondary containment. Two much smaller steel tanks are within cement secondary containment next to a cement (but without berm/curb) unloading area. Drains to a sump seemed to be present. The large tank appears to be in violation of state and federal law but when asked about it a representative of the Office of Oil and Gas stated it didn't need secondary containment, the tank was double walled, with an inner and outer wall providing containment.[7] Examination of the large paper file in the Office for the well found, in documents related to the sale of the well to the current operator in 2008, mention of the "57,000 gallon ground, double-walled tank" but nothing about the tank having two walls. Industry's *double walled* nomenclature can mean a tank with a wall twice as thick as standard. Such a tank would require secondary containment.[8] (Further discussion about the issue of double walled tanks appears on page 15.)

Activity on the well site in the past severely polluted ground water (a 2003 test shows benzene in ground water at 3,400 ppb; the Maximum Contamination Limit, MCL, for benzene is 5 ppb).[9] The previous operator initiated a federally imposed cleanup which required removing large amounts of soil from the site. Tupper's Creek which runs alongside the site wasn't affected. Cleanup was finished at the time of the sale in 2008.

[7] We deliberately have not used the term double walled in the past even though we knew some tanks we have seen were double walled, i.e., had extra thick walls to resist corrosion or vandalism. 35CSR1.7 has no mention of a double walled tank as meeting spill prevention requirements for adequate secondary containment.

[8] Condition 19 of the well's October 2012 Permit Modification requires secondary containment for all tanks and for unloading area.

[9] Applied Geology and Environmental Science, Inc., 1 November 2008, *Tuppers Creek UIC Well, Kanawha County, West Virginia, Groundwater Monitoring Results—3rd Quarter 2008.*

Photo 8. The UIC class 2 facility next to Tupper's Creek (47-0039-02210). The containment with two smaller tanks is in the right foreground. In the center of the photo is the 57,000 gallon tank. Utility buildings and the injection well are behind the large tank. The site is well secured with fencing and locked entrance gates. Photo taken on 6 April 2013.

When we visited in April 2013 there was a very strong and acrid condensate odor (the large tank is labeled with a warning about flammability). There is a residence across the street from the UIC class 2 site and a church a short distance away. Documents in the UIC class 2 well's paper file included a complaint of medical harm made by a local resident. The well's UIC permit (condition 21 of the 2012 permit) requires a "vapor recovery system" on all tanks to prevent odors. We couldn't find documentation within the file showing that a vapor recovery system is actually present on the tanks.

The UIC class 2 well in the Amherst Plymouth WMA (47-079-01452) is non-commercial; it can only be used to dispose of that operator's waste. The well is located about one mile east of the WMA entrance off State Route 62.

We were impressed by what we saw at this site and would like it to be a model for UIC class 2 wells in the state. Site access is restricted. Vehicle traffic is prohibited by the DNR and the gate to the WMA is always kept locked. The UIC class 2 facility has good fenced security and signage and we didn't smell any odors even though a vac truck had unloaded only a short time before our visit.

The six steel storage tanks sit within cement secondary containment. There is a cement unloading pad, with curbs/berms, sloped toward a sump. The work area is set on a cement platform above the sump and is covered with a steel grate. Any spills go into the sump.

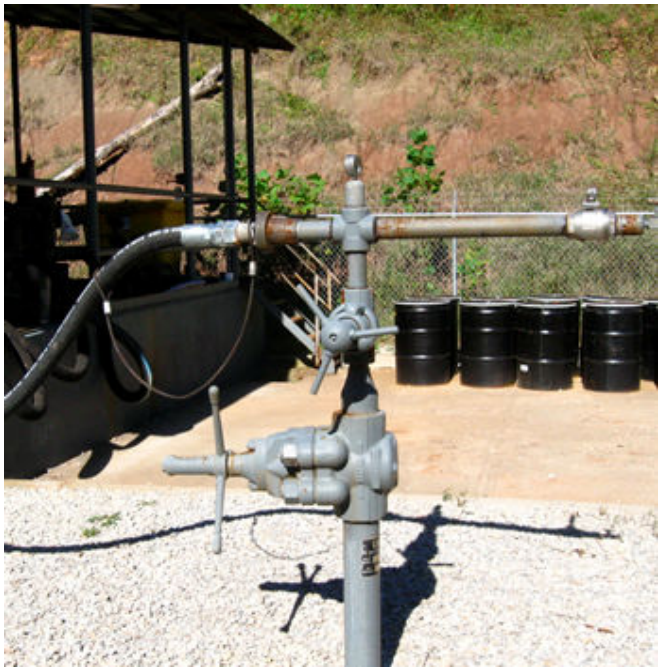

Photo 9. The UIC class 2 wellhead at 47-079-01452. The black pipe to the left carries fluid to the well. There's a pressure gauge on top of the wellhead. The annulus pressure gauge is hidden by the well in this photo. The cement unloading pad is visible behind the wellhead. The pad is sloped toward the work area and toward the sump under the steps behind the wellhead. Photo taken on 6 April 2013.

The wellhead has a pressure gauge and another gauge for tubing annulus pressure is nearby.

We will discuss further aspects of these and other UIC class 2 wells and operation below (page 6).

Second Gas Well Workshop

The 2013 Gas Well Workshop, sponsored by the West Virginia chapter of the Sierra Club, followed the basic framework of the first Workshop given in 2012. There were three week-long sessions along with field trips held in the northern and southern parts of the state.

Workshop materials are available online at http://www.sootypaws.net/gws/class/. Materials for each session include videos and readings. An

Photo 10. 2013 Gas Well Workshop field trip where George and participants are discussing the completion report for a well we visited. Photo taken on 6 April 2013.

exercise was also part of each session. Emphasis was given on using state databases for locating wells and finding information, including producing formations. Conference calls were held twice a week to discuss issues or answer questions.

The first Workshop had a focus on locating and determining environmental pollution; the second's focus was more general.

Videos and handouts were updated with the majority of the changes being made to the online database materials.

The field trips were well attended. That in the north visited 47-077-00493, 47-077-00442, and 47-077-00558 (not drilled yet) horizontal well sites. The southern trip which we led visited three sites, two of which are described earlier (page 1). We intended to show some of the infrastructure (pipelines, a compressor station and a large transmission station) and history of drilling in our area, including phases of exploration by particular formations (Big Lime, Oriskany as part of the Elk-Poca field, and more recently shale including Marcellus). The wells we looked at were vertical, one newer, two older. After looking at the first well, participants made evaluations of the features of the second and third wells.

West Virginia Underground Injection Control Class 2 Well Program

The Underground Injection Control (UIC) program for West Virginia is managed by the state's Department of Environmental Protection; West Virginia gained primacy from the EPA in the 1980s. The UIC programs for different classes of injection are dispersed within the agency. The Office of Oil and Gas manages the class 2 program — injection of liquid waste resulting from oil and gas activities. This waste includes produced water/brine and flowback.

Operation of the program by the Office is best seen by comparison of UIC wells within the state. The operation of the program can also be examined through the lens of EPA's Guidance #77[10] for state programs overseeing commercial UIC class 2 wells. When asked about Guidance #77's requirements the Office seemed unaware of their existence.

Comparison of Wells

We will compare security, site layout, operation, and pollution for four wells. We visited two wells, 47-039-02210 and 47-079-01452. The former is a commercial well. We prepared comments in 2013 on operators' permit applications for two other wells, 47-019-00460 and 47-085-09669; both of these wells are commercial. All four wells have different operators and are in different counties.[11]

Security of UIC class 2 wells in West Virginia is variable. The two wells we looked at both had fenced sites and restricted access (locked gates). The 47-019-00460 site is not fenced. The 47-085-09669 site is fenced, according to Google Earth imagery. Access is open (open or unlocked gates), however, for both of these sites. Security of commercial facilities is required by Guidance #77.

Layout of sites is important to help support the proper management of waste during unloading into pits or tanks. Ground contact by waste should always be prevented (the state's Groundwater Protection Rule, 47CSR58, has specific requirements). Tanks have to be placed in secondary containment. West

[10] EPA, 22 June 1992, *Memorandum: Operating, Monitoring and Reporting Guidelines for Class IID Commercial Salt Water Disposal Wells – Underground Injection Control Program Guidance #77.*

[11] Collections of documents, Google Earth images and photographs for these sites can be accessed through http://www.sootypaws.net/gws/uic.

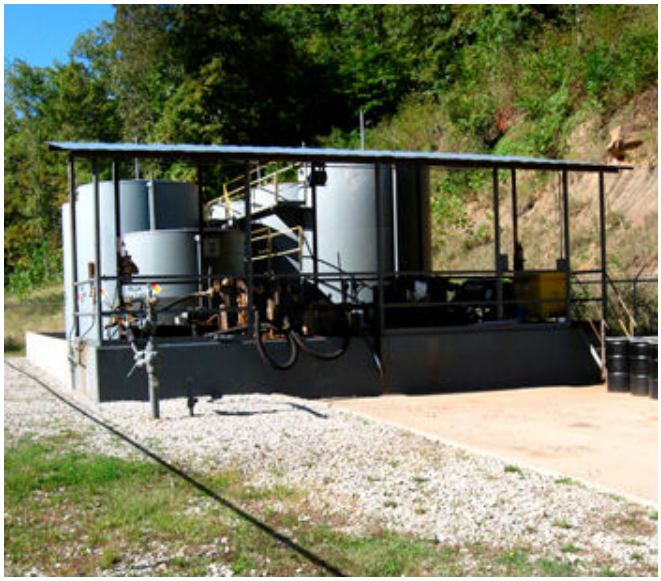

Photo 11. The UIC class 2 well facility in the Amherst Plymouth WMA (47-079-01452). The cement unloading area (with curb) is in the right foreground. The work area with pump and filters is in the middle ground. A steel grate covers the whole work area platform so that any spilled fluids go into a sump. The tank battery within a cement lined secondary containment is visible in the background. Photo taken on 6 April 2013.

Photo 12. The tank battery at the UIC class 2 facility in the Amherst Plymouth WMA (47-079-01452). The 6 large tanks sit within cement lined secondary containment. The work area is covered with a metal roof toward the middle right of the photo. Photo taken on 6 April 2013.

Virginia has no published guidelines for UIC class 2 operators and operators appear to be unaware of (or reluctant to construct) secondary containment for tanks. This requirement is in state law.[12]

The two sites we examined had cement unloading pads, though 47-039-02210's wasn't curbed. All the tanks at 46-079-01452 were within cement lined secondary containment. The large tank (57,000 gallons) at 47-039-02210 has no visible secondary containment. Neither the 47-085-09669 or the 47-019-00460 sites have cement unloading pads; spills are onto ground or gravel. Some, but not all of the tanks at the 47-019-00460 site are in secondary containment; the secondary containment for the tanks does not meet the law's requirements. 47-085-09669 received a reprimand by the inspector (though not a Notification of Violation, NOV) for not having storage tanks within secondary containment on 13 July 2012. The 3 June 2013 Google Earth view of the site appears to show containment in place. 47-019-00460 has never in more than a decade of operation satisfied completely the law's requirements.

Operation of a UIC class 2 well requires keeping track of volumes of waste disposed of, maximum injection pressure, flow rate, and tubing (and sometimes production casing's) annular pressure. Measuring and recording volume, maximum pressure and flow rate are federal requirements for state programs with primacy.[13]

It wasn't possible, because of distance from the fence, to verify a pressure gauge being present on the 47-039-02210 well. A maximum injection pressure gauge was present on the 47-079-01452 well, along with a tubing annulus pressure gauge.

West Virginia requires operators file a monthly WR-40 form which satisfies federal and state requirements for UIC class 2 wells. We have examined WR-40 forms for 47-039-02210, 47-019-00460, 47-085-09669, and another well (47-007-02539). All the forms were deficient in information

[12] The Groundwater Protection Rule, 47CSR58, requires unloading areas with spill prevention and secondary containment (4.4) and above ground storage tanks with secondary containment, including an impermeable barrier between tank and groundwater (4.8). The oil and gas rule for secondary containment is found in 35CSR1.7.

[13] The states' reporting requirements are found in 40CFR146.23.

WR-40

STATE OF WEST VIRGINIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
REPORT FOR WASTE DISPOSAL WELLS

DATE 10/15/2012
WELL NO. Shanley 6A
API PERMIT NO. 085-09669

OPERATOR NAME: Hall Drilling, LLC

MONTH: September 2012

**********MAXIMUM PERMITTED INJECTION PRESSURE 1995 PSIG**********

DAY	OPERATING HOURS	ANNULUS PRESSURE		MAXIMUM DAILY INJECTION PRESSURE	SHUT IN PRESSURE	VOLUME IN BBLS AND/OR MCF.		RATE IN GALLONS PER MINUTE	
		TUBING	OTHER			DAILY	ACCUMULATED	AVERAGE	MAXIMUM
9/1/2012	0	NA		NA	NA	0	306,781	0.00	0.00
9/2/2012	0	NA		NA	NA	0	306,781	0.00	0.00
9/3/2012	18	1,700		1,700	1,400	1,166	307,947	45.36	45.36
9/4/2012	12	1,925		1,925	1,700	778	308,725	45.36	45.36
9/5/2012	18	1,800		1,800	1,650	1,166	309,891	45.36	45.36
9/6/2012	18	1,900		1,900	1,800	1,166	311,058	45.36	45.36
9/7/2012	18	1,950		1,950	1,900	1,166	312,224	45.36	45.36
9/8/2012	0	NA		NA	NA	0	312,224	0.00	0.00
9/9/2012	0	NA		NA	NA	0	312,224	0.00	0.00
9/10/2012	12	1,800		1,800	1,600	778	313,002	45.36	45.36
9/11/2012	12	1,825		1,825	1,625	778	313,779	45.36	45.36
9/12/2012	12	1,800		1,800	1,575	778	314,557	45.36	45.36
9/13/2012	18	1,825		1,825	1,600	1,166	315,723	45.36	45.36
9/14/2012	18	1,925		1,925	1,825	1,166	316,890	45.36	45.36
9/15/2012	0	NA		NA	NA	0	316,890	0.00	0.00
9/16/2012	0	NA		NA	NA	0	316,890	0.00	0.00
9/17/2012	18	1,850		1,950	1,000	1,166	318,056	45.36	45.36
9/18/2012	18	1,950		1,950	1,850	1,166	319,223	45.36	45.36
9/19/2012	18	1,950		1,950	1,850	1,166	320,389	45.36	45.36
9/20/2012	18	1,950		1,950	1,050	1,166	321,555	45.36	45.36

Photo 13. Portion of the September 2012 WR-40 for UIC class 2 well 47-085-09669. WR-40 forms are submitted monthly by the operator. Red and green circled items on the form are explained in the text.

they provided; data in 47-085-09669's appears to be a pure fabrication (see photo 13).

The green circles surround matching pressures in the tubing annulus and maximum daily injection pressure. 40CFR146.8 states that "An injection well has mechanical integrity if there is no significant leak in the casing, tubing or packer . . ." (this is also found in 47CSR13.6.2). Matching tubing annulus and injection pressures provide evidence of a major tubing or packer leak. Monitoring of these pressures is a requirement in state UIC class 2 permits (for example, 47-085-09669's 2010 permit requires monitoring annulus pressures in condition 12 and monitoring injection pressures in condition 15).

Monitoring of a well's pressures and periodic Mechanical Integrity Tests (MITs) are vital. Low pressure "backside" MITs, such as conducted at 47-085-09669 on 15 March 2010, do not meet the law's requirements, especially when that operator's WR-40 reporting shows lack of tubing/packer integrity.[14]

Red circles surround example data sets on the form. The daily operating hours are either 18 (circled) or 12. The daily volume is either 1,166 barrels (circled for 18 hour days) or 778 barrels (for 12 hour days). The average flow rate per minute is 45.36 gallons. Multiplying the operating hours by flow rate produces the daily injected volume and the figures are invariable, thus A x (C x 60)/42 = B.

Every day of operation in September 2012, then, shows 778 barrels exactly and invariably for 12 hours of operation or 1,166 barrels exactly and invariably for 18 hours of operation. If these figures are true, every minute of every hour of operation was spent injecting fluid with no stoppages or breakdowns.[15] And the amount injected was exactly the same in spite of variation in daily maximum injection pressures (1,700 to 1,950 psi).

Since UIC class 2 operators' reporting of total fluid injected and flow rate are required by federal law (40CFR146.23) for states with primacy the figures on the state's WR-40 have to be as precise as possible. Reporting such as found on this form show

[14] A copy of this Mechanical Integrity Test is available at http://www.sootypaws.net/gws/uic/85_9669/MIT_85_9669.pdf. Pressure was at 1,000 psi, while maximum permitted injection pressure for this well is 1,995 psi.

[15] Office inspection reports dated 8 June 2011, 9 November 2011, and 13 July 2012 show no flow at the time of inspection, yet these were all days that had continuous flow according to the WR-40 reports.

that 47-085-09669 is not meeting conditions of the permit and the state is not enforcing compliance.

Pollution is present, or had been present, at two of the wells, 47-039-02210 and 47-019-00460. The pollution at the 47-039-02210 site was due to activity on the site, rather than injection underground, and appears to have been remediated. Pollution at the 47-019-00460 site is still undergoing study. The stream alongside the facility shows obvious pollution.[16] The Office is invested in an acid mine drainage cause brought about by the construction of two large pits alongside the stream disturbing mine spoil. Recent water tests have shown, variably, low to elevated chloride (up to 301 ppm, above the state's chronic concentration limit for freshwater streams). Chloride is not associated with acid mine drainage but is associated with oil and gas pollution. An April 2013 lab test of a stream sample also showed various glycols (associated with products used in hydraulic fracturing that would be found in flowback) and methane (a high concentration unusual in running stream water). The surface of the stream has, in places, a hydrocarbon based scum or gel, which could be associated with flowback. Unfortunately samples from the stream have been collected by various parties in a hit or miss fashion. Locations are unknown or have vague descriptors (e.g., "downstream").[17]

Air pollution has been a feature of the 47-019-00460 site leading to a number of complaints by residents living near and at some distance (miles) from the well.[18] When we visited the 47-039-02210 site an objectionable strong odor was present.

We have heard anecdotal evidence of health problems for UIC class 2 workers. A medically disabled man gave negative oral comments at the public hearing on 4 June 2013 for the renewal of 47-019-00460's permit.[19] He associated his health problems to working at the well. We understand that a worker at the 47-085-09669 well is also struggling with health problems.

Problems with the State UIC Class 2 Program

The state program has problems in areas covered by Guidance #77: complaints, inspections, and compliance enforcement. George examined the paper files for the 47-039-02210 and 47-019-00460 wells (other files also exist on the agency's intranet). Very few complaints were present and never with associated agency response (inspection and, if necessary, compliance enforcement). The Office, for other types of wells, keeps complaints and resultant agency action discretely separate. What this means is that there is no real way to determine if and how the Office is responding to complaints. Comments given at public hearings for the 47-019-00460 well permit renewals indicate a strong concern about lack of agency response.[20]

Inspections by law must be "periodic" (40CFR145.12) and Guidance #77 recommends, for commercial wells, surprise inspections which include the collection of waste samples for laboratory analysis.[21] Inspection reports are filed on the agency's intranet. Files on the intranet for UIC class 2 wells are organized by well and date and not by type. An inspection report, therefore, on the intranet can only be found by hit or miss searching through all the well's files on the intranet. Complaints are an independent category on the intranet and are filed by date. Unless an inspector has noted it on a complaint form, the well's API number is unknown.

Inspections are noted on the public online databases, but those databases are corrupt. The 47-039-02210 well, according to which database is examined, is operated by the correct operator or the former operator with inspections on differing dates.

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[16] For a video shot in early May 2013 see http://youtu.be/wmZiI3ZX9E8.

[17] Copies of lab reports can be accessed through http://www.sootypaws.net/gws/uic/webb.html.

[18] For example, the 10 July 2007 letter from Philip Perone of the Fayette County Health Department to the Office: "Several times we have been asked to investigate nuisance odors coming from the proximity of the well. We have never received an explanation as to the source of the odors, potential health risks, chemical composition of materials going into the well(s), or any other information that would be useful for public information."

[19] Peter Halverson's comments begin on page 35 of the transcript of 4 June 2013 public hearing.

[20] Transcripts of public hearings held on 6 September 2007 and on 4 June 2013 are available at http://www.sootypaws.net/gws/uic/webb.html.

[21] "At a minimum the UIC programs should conduct annual, unannounced . . . inspections of each commercial facility. These inspections should include collection of a 'grab sample' of fluid . . ." (pages 4-5). The purpose of these inspections is to make sure the operator is only injecting permitted fluids. The Office issued a Notification of Violation to 47-019-00460 in 2010 for injecting waste oil.

One database shows the well as having received a plugging permit.[22]

Compliance enforcement is the main theme of Guidance #77 and the excellent, though dated, EPA UIC well inspector's manual.[23] Compliance enforcement proceeds through a regular step by step process, always with the final option of court proceeding. The Office, as shown by the 47-019-00460 well, is adverse to exercising compliance enforcement.

The operator of 47-019-00460 has been able to successfully sidestep the Office for more than a decade, ignoring permit conditions, contesting NOVs, and not complying with a Consent Order.[24] In spite of this an Office representative told us that the operator was in full compliance.

The operator's 2007 permit had three amendments as part of condition 25: the Office would train the operator's employees in proper UIC well operation;[25] the operator would close the two pits within six months; and the operator would provide security for the site. These amendments were due to problems encountered with the operator during the previous five years of operation.

Shortly after the 2007 permit was in effect, the operator contested closing the pits. According to a 12 March 2008 letter from the DEP's legal office to the operator's attorney, the operator "had verbally agreed with DEP personnel to fill the pits prior to the requirement being included in the permit." An internal DEP attorney work product found "no grounds for modification deleting the requirement that the pits be closed and backfilled."

On 12 May 2008 the Office issued a NOV to the operator for being in violation of the permit because of the pits. To abate the violation the operator must "close pits as ordered." An 8 July 2008 letter from the Office to the operator states: "Non-compliance with any permit condition may result in revocation or suspension of a UIC permit per 47CSR13.19."

On 6 November things finally came to a head. The Office backpedaled in Consent Order 2008-15. The Order states that the operator can keep the pits because of Office training of the staff and "enhanced" site security (a gate was finally installed), the two other amendments to the 2007 permit's condition 25.

The Consent Order did have requirements that the operator sample twice a year the stream running alongside the pits in two rather vague locations (adjacent to the pits and "downgrade") and the pits themselves for a list of constituents. The operator nominally met the Order's requirements once over the ensuing years (see Appendix 1 on page 20).[26]

On 21 September 2010 a new NOV was issued to the operator for having fluids in the pits not permitted for class 2 injection. The inspector's wording, "Underground Injection Control permit (#2D0190460) is hereby revoked/terminated for non-compliance," in the NOV was later changed to "suspend [sic]." The Office was ready to give another permit in early 2013 but public concern has delayed that. The operator is being allowed, in the mean time, to inject waste without a permit.[27]

It is apparent by the Office's actions that it cannot or will not ever shut down an operator once the operator has a permit no matter how egregious that operator's actions.

This calls into question the Office's claim that no UIC class 2 well has ever contaminated ground water. The Office would only know that if an operator, or someone else, told them. And even if, as in 47-039-02210's case, groundwater is contaminated, the operator will be allowed to continue their activities.

The Waste Being Disposed Of

Liquid waste is injected deep underground using UIC class 2 wells. This waste takes a variety of forms depending on its source. Certain waste apparently requires additional site structures which ostensibly are used to settle out particles from coalbed methane produced water before the waste is

[22] Printouts of database results can be seen at http://www.sootypaws.net/gws/uic/39_2210/39_02210%20OOG%20database%20results.pdf.

[23] Engineering Enterprises, Inc., 1988, *Underground Injection Control Inspection Manual*.

[24] Documents discussed in the text can be found at http://www.sootypaws.net/gws/uic/webb.html.

[25] Guidance #77 on page 5 recommends that states furnish commercial UIC class 2 operators with a handbook specific to a permitted well with operational guidelines, summary of regulations, and other materials to help operators perform properly.

[26] Appendix 1 has the list of constituents and a table showing the operator's sample dates, locations, and whether the operator met the Order's conditions. The lab tests themselves can be seen by going to http://www.sootypaws.net/gws/uic/webb.html.

[27] Injection is shown as taking place on the April 2013 WR-40.

Photo 14. The entrance gate for the Plymouth Amherst WMA off Route 62. The gate is always kept locked. When we visited a vac truck passed us as we hiked into the WMA. It had just left the UIC class 2 well a mile beyond this gate. Photo taken on 23 September 2013.

injected. The pits at the 47-019-00460 facility serve this purpose even though coal fines seemingly do not cause problems for low chloride liquid waste ground application systems at coalbed methane wells in West Virginia. The pits at the 47-085-09669 facility are used solely for flowback storage until it is recycled or injected.

Appendix 2, Table 2 (page 22), has lab results for the constituents in pits at the 47-085-09669 and 47-019-00460 facilities. Drinking water MCLs are given alongside to give an idea of toxicity of various constituents.

Generally, toxicity is due to the presence of high concentrations of specific chemicals: certain hydrocarbons such as benzene, heavy metals such as barium or arsenic, radioactive elements such as forms of radium, and high concentrations of chloride, which is toxic to the environment. Some of these chemicals can exist in both liquid and gaseous states.

High chloride concentration is a hallmark of liquid oil and gas waste. The highest concentrations of heavy metals and radioactive elements are a feature of Marcellus well flowback. Hydrocarbon sources vary. While the presence of hydrocarbons can

Photo 15. The work platform at the UIC class 2 facility in the Amherst Plymouth WMA (47-079-01452). The cement walled platform is covered with a grate so spilled fluids go into a sump. The black pipe in the foreground goes to the injection wellhead. Photo taken on 6 April 2013.

be tied to specific chemicals used as products in hydraulic fracturing, some of which contain benzene or glycols, the more common source is crude petroleum (for the BTEX chemicals – benzene, toluene, ethylbenzene and xylenes) often found mixed with natural gas.

Marcellus flowback can have both high metals and the presence of NORM (Naturally Occurring Radioactive Materials); the formation is considered highly radioactive. Laboratory tests conducted by the DEP at the Davis well in Wetzel county in 2009 demonstrate that the constituents' concentrations in flowback vary over time. These lab results are shown in Appendix 2, Table 3 (page 23), again with drinking water MCLs for comparison. One thing to note is the intimate link between high concentrations of barium and high combined concentrations of radium 226 and 228.[28]

The state in its UIC class 2 permit requirements for operators' testing of fluids has only recently begun to include radioactive elements.

Management of waste because of its known or probable toxicity is therefore important to protect

[28] The link between high concentrations of barium and combined radium 226 and radium 228 is discussed in Theodore F. Buckwalter and Michael E. Moore, 2007, *Ground-Water Resources and the Hydrologic Effects of Petroleum Occurrence and Development, Warren County, Northwestern Pennsylvania*, page 49.

human health and the environment. Every effort should be taken to prevent even small spills.

A Model UIC Class 2 Well

The Putnam county UIC class 2 well we looked at in the Amherst Plymouth WMA (47-079-01452) has the physical features we want to see at the state's UIC class 2 wells. Access to the well is limited by a gate that is always kept locked. The site itself is entirely fenced. There are no open pits at the site, instead fluid is stored in large tanks set within cement lined secondary containment. There is a curb or berm edged cement unloading area with a pumpable sump. There is no possibility of ground contact from spilled fluids. The well has gauges present for monitoring maximum injection and annulus pressures.

This describes the physical exemplar. We also are looking for a well whose operation meets permit requirements and conditions. If flappers or vapor recovery units are required by the permit for tanks, their presence must be documented where we can find it in the well's paper files at the Office. Source lists and constituent tests, when required, have to be submitted by the operator and present in the file (contrast this with the permit-required source lists for 47-019-00460 which don't exist). Reporting by operators on WR-40 forms has to be precise and truthful. The absence of documentation points to an operator not meeting legal obligations and the Office not enforcing compliance.

The Office needs to actively pursue a program of enforcement. Lack of enforcement of NOVs or Consent Orders should not exist. Operators who cannot fulfill the requirements of their permits, NOVs, or Consent Orders should be shut down.

Online Course Created

A section of the West Virginia chapter of the Sierra Club's Marcellus website was created to provide a "course" with descriptive summaries of major issues in West Virginia horizontal Marcellus development. Links are provided to core primary and secondary resources.[29]

The issues were broken down into fundamental categories: regulatory framework, site construction, well construction, hydraulic fracturing, water, air, waste management, and public health.

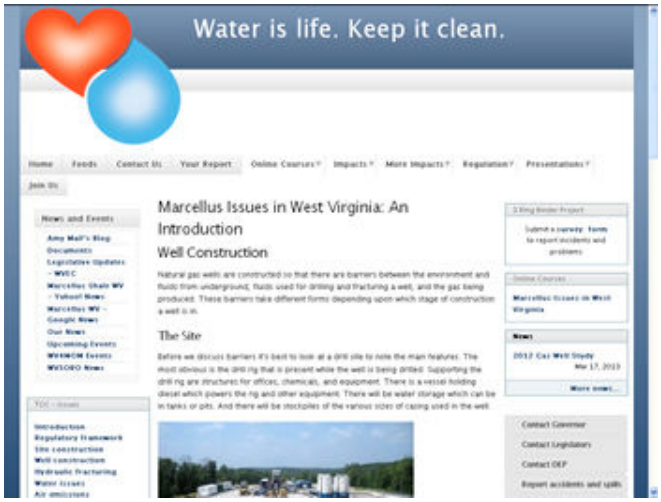

Photo 16. Screen shot of the online course section for the West Virginia chapter of the Sierra Club's Marcellus-WV.com website.

The introduction provides links to online videos. There are links to industry videos prepared by Chesapeake and Cabot explaining their operations and drilling and completion processes. Older films, such as *Louisiana Story*, commissioned by Standard Oil, show how attitudes have changed over time. A link to a two hour video of a talk by Dr. Tony Ingraffea provides a background or framing for the issues covered within the course.

The regulatory framework section provides links to law and regulation, including the new Horizontal Well Act. This section also includes a link and short discussion about the 2012 Legislative Audit of the Office and links to and discussion of the Office's *West Virginia Erosion and Sediment Control Field Manual* and General Permit for Water Pollution Control.

The site construction section includes links to and discussion of industry's RAPPS manual (which we wish the Office would adopt), the study done for the EPA in Denton, Texas, and other studies related to erosion and sediment control and well site construction.

Well construction describes the various phases of drilling and shows the necessity of at least two barriers to protect the environment. Barriers include the blowout preventer and casing and cementing. The possible failure of these barriers is documented with mostly out of state examples, such as a casing

[29] http://marcellus-wv.com/online-courses

burst and casing hard landing at an Ohio well (CNX Gas Company's Mahn #7 well in Mahoning county). There is a link to materials related to the 1980s groundwater contamination due to hydraulic fracturing that occurred in West Virginia.

The hydraulic fracturing section focuses on chemicals/products used in hydraulic fracturing with links to a number of Material Safety Data Sheets (MSDSs). Separate pages provide information and MSDS links for specific hydraulically fractured wells in West Virginia: the 2008 Halliburton fracturing of 47-093-00107 in Tucker county; a horizontal Marcellus well, 47-097-03686, fractured in March 2011 in Upshur county; a horizontal Marcellus well, 47-091-01220, fractured in September 2011 in Taylor county; and a horizontal Marcellus well, 47-103-02565, fractured in Wetzel county in February 2011. These pages also include links to completion reports and, for the 2011 wells, FracFocus reports.

The water and air issues sections have background discussions with links to pertinent studies. The air issues section depends heavily on studies resulting from air quality testing in Colorado since 2004.

In the waste management section the types of waste, and methods of disposal such as land burial of drill waste, are described along with specific issues related to each. The West Virginia regulatory framework for waste is examined before turning to issues with the West Virginia waste management program. The Office's inability to revise and update the General Permit for Water Pollution Control is a continuing concern, as is the lack of UIC class 2 compliance enforcement.

Public health issues section is entirely too short. The studies that are available are almost all from Colorado where there's been concern over public health and some effort to determine the validity of that concern. The papers linked to tend to be very technical though they have findings showing cancer causative effects of single large-dose exposure to benzene and importance of distance from a natural gas well site during completion and production for reducing likely health consequences.

The online course section of the Sierra Club chapter's website will be revised periodically to bring in more applicable materials (such as legislatively mandated studies released in 2013) and as more is known about topics considered. The section is text heavy. We hope to add more photographs and maybe a photographic description of a well from site construction and drilling to completion, reclamation and production.

Photo 17. This is what the inspector in the Office's report wrote about 47-079-00615: "double walled tank looked o.k." The tank is leaking at the valve at the bottom and requires replacement or repair. The single wall tank requires secondary containment. Photo taken on 26 February 2009.

Response to Office of Oil and Gas Report on *Gas Well Study, 2012* Wells Investigated

We appreciate the Office's effort in looking at the wells that appear in our *Gas Well Study, 2012*.[30] We know how much time is involved in the preparatory work before a site is examined and how much time it takes inspecting well sites.

At the same time we feel that five main issues with wells we examined in 2012 weren't addressed. These issues are: missing or incorrect API numbers (5 of the 17 wells); nonexistent or inadequate (including missing rainwater drain) secondary containment at sites where there were tanks (5 of 9 sites); evidence of surface contamination (3 sites had high soil chloride, plus one of the 2012 sites revisited in April 2013); poorly maintained roads including damaged waterbars; and a number of sites

[30] A copy of the Office's report is provided in Appendix 3.

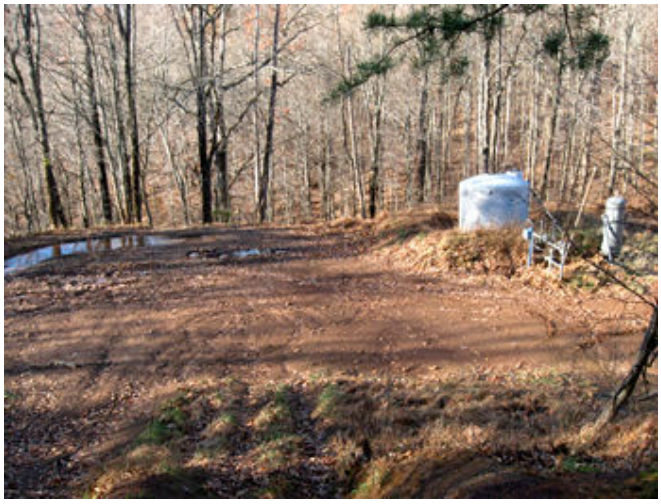

Photo 18. This provides a view of the mostly bare pad for 47-079-00702. The bare pad extends an equal distance to the left of the photo. Vegetation on the pad surrounds the well equipment only. The inspector wrote of this site in the Office's report: "site looked good with grass/vegetation growing." Photo taken on 18 November 2013.

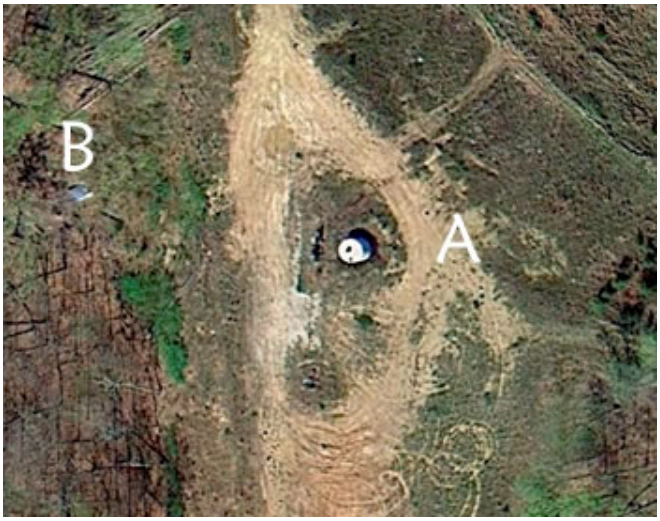

Photo 19. This is a 26 March 2012 Google Earth view of the pad for 47-079-01314 which shows vegetation coverage problems we found in 2012 and earlier visits. The letter A indicates the approximate location where samples showed high chloride in soil and surface water. The letter B shows the location of the blue portolet which has been pushed into the undergrowth away from the pad.

having trash including an abandoned steel tank that wasn't associated with a particular site. The sites we looked at in 2012 that had significant issues included 47-039-01168, 47-079-00615, 47-079-00702, 47-079-01314, 47-079-01492, and 47-097-03716. It appears from the Office's report that issues at 47-039-01168 were addressed.

Before we discuss the five main issues we will look at three sites we returned to in 2013: 47-079-00615, 47-079-00702, and 47-079-01314. They have been described earlier. We will look specifically at the Office's investigation findings for each (the Office's report is reproduced in Appendix 3).

47-079-00615

The Office inspected the site on 24 June, after our April revisit during the Gas Well Workshop field trip. The Office's report states: "well is abandoned," "site looks good with grass/vegetation growing – in compliance," and "double walled tank looked o.k." The inspector didn't note the lack of an API number, or the recent maintenance trash (pieces of pipe). The site is well vegetated but the tank plainly doesn't have two walls and was leaking in April. We will return to the issue of double walled tanks below (page 15).

47-079-00702

The Office inspected the site on 8 July, we revisited in November. The inspector found: "double walled tank with tank dike," and "site looked good with grass/vegetation growing." Our visit in November found the well access road had deteriorated since our 2012 visit. The pad is about 80% bare of any vegetation. The large plastic tank is sitting within secondary containment but there is no rainwater drain as required in 35CSR1.7.

47-079-01314

The Office inspected the site on 25 June, we revisited in November. The inspector found: "access road in good shape, no evidence of runoff/erosion," "drains in good condition," and "area has good vegetation." In November we found the well finally had the right API number but the tank's secondary containment still has no rainwater drain. The pad is about 50% bare of any vegetation. The access road spur is deeply rutted, side ditches were filled with sediment. The ditches for the main access road were also filled with sediment or non-existent. The Office's report made no mention of our findings in

Photo 20. This is a view inside the tank at 47-079-00615 which the Office's inspector called "double walled." The tanks appears to be a reused septic tank and has only one wall. Photo taken on 12 October 2012.

2010 and 2012 of contamination on the pad in the area of the former pits.

API Numbers

The legal requirement for a proper API number on a well is a minimal demand on an operator.[31] For us, the presence or lack of an API number is a broad indicator of industry compliance with state and federal laws.

Five of the 17 wells had wrong or no API numbers in 2012, yet the Office's report only notes this being corrected at 47-039-01168. Does this mean that 47-079-00731 still has the wrong API number, and 47-079-00615 and 47-079-00739 (apparently not visited by an inspector) still have no API numbers?

Secondary Containment

In 2012 we found secondary containment lacking at 47-079-00615 and for a tank on the Cranberry pipeline. We found containment breached at 47-079-00731 and no rainwater drains for containment at 47-079-00702 and 47-079-01314. According to the Office's report the operator will repair the containment at 47-079-00731. No mention in the report is made of the missing rainwater drains at the two Putnam county sites.

The Office in the report seems to find missing containment at 47-079-00615 and the Cranberry tank not a problem at all because these tanks are "double wall" tanks.

Double wall for the industry can mean a tank with walls twice the thickness of single wall, e.g., 12 gauge rather than 16 gauge steel). This adds confusion as to whether or not a tank actually has two separate walls.

The EPA recognizes double walled (with two separate walls) tanks as meeting federal SPCC requirements if they are made of steel, the tank has overfill protection (including alarm and automatic shutoff or restrictor), and all fluid transfers are constantly monitored.[32]

We were told in 2008 by an Office's inspector that the (now former) 50 barrel steel tank at 47-039-02026 was double walled.[33] The inspector said that no one would be able to shoot a hole in it. This tank overflowed in the winter of 2007/8, in 2010, and again in 2011 before it was replaced. The tank did not have secondary containment until September 2008 so the first overflow sent crude petroleum and brine over the hillside toward a stream. Any tank with an open vent to the atmosphere can leak. The Cranberry tank has such a vent.

The plastic tanks on the Cranberry pipeline and at 47-079-00615 do not meet the law's requirements. The plastic tank at 47-079-00615 has open inlet and outlet holes near the top, which allow inspection of the interior of the tank. A revisit of the site in April 2013 found fluid dripping from the tank's bottom valve. A test for chloride in the soil found >641 ppm (above the upper limit of our test).

The issue of double walled tanks is important. The tank at 47-079-00615 may have thick walls but it certainly does not have two separate walls.[34] And the tank isn't fully enclosed. That an inspector is calling this tank and the similar Cranberry pipeline

[31] Requirement for API numbers is in 35CSR4.5.5.a.

[32] EPA, nd, *Memorandum: Use of Alternative Secondary Containment Measures at Facilities Regulated under the Oil Pollution Regulation (40 CFR Part 112)*. Marianne Lamont Horinko, Assistant Administrator, OSWER 9360.8-38.

[33] The steel tank at 47-079-01324 shown in Photo 5 is of the same type.

[34] Anyone who has worked with plastic tanks knows just how brittle they are and susceptible to breakage.

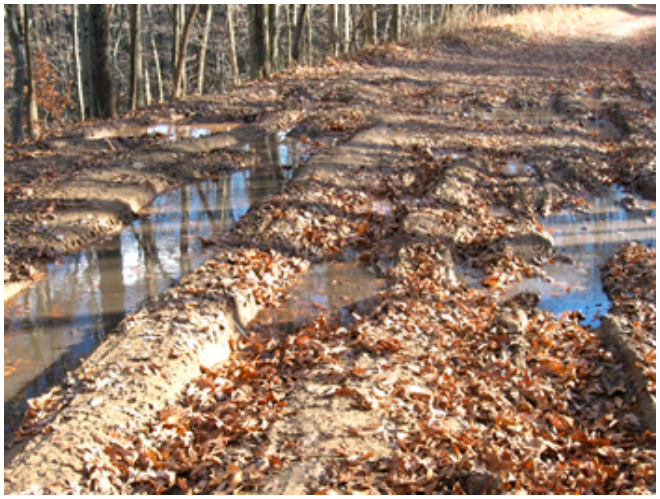

Photo 21. This photo shows the main well access road for a number of gas wells (what we call the Long Road). This spot is just north of 47-079-00702 and is deeply rutted. The Office's report found no issues with the road – "drains in good condition." Photo taken on 18 November 2013.

tank double walled and therefore not needing secondary containment is troubling. If the 57,000 gallon tank at 47-039-02210 UIC class 2 site is similarly "double walled" as these tanks (and we found nothing in the well's file saying differently), then that operator is in noncompliance with state and federal law.

The Office is doing a disservice to itself and the public when it calls single wall tanks doubled walled and removes them from needing regulatory compliance. The Office has problems enough without attaching the issue of competence to its actions.

Contamination

Contamination was noted at four sites, evidenced by exposed pit liner (47-079-01288, 47-079-01314, and 47-079-01492) or measured pollution (47-079-01492 in 2009,[35] 47-079-01314 in 2010 and 2012, and 47-097-03716 in 2012). A return to 47-079-00615 in April 2013 found chloride in the soil near the leaking tank at >641 ppm.

The Office's report didn't respond to issues of contamination and found 47-079-01314 "well vegetated" even though a sizeable portion of the pad when visited in 2008, 2010, and 2012 has been bare. When we revisited the site in November 2013 we found no improvement, if anything deterioration of the sparsely vegetated pad. We also found the remains of bonfires in two locations between the wellhead and the condensate storage tank. This, and other wells accessed by the Long Road, are deadly accidents waiting to happen because of open access.

Roads

Road issues, including damaged waterbars, were addressed by operators only at 47-039-01168 and 47-079-00731, according to the Office's report (we found the road to 47-079-00731 acceptable in 2012). The well access road for 47-079-01299 and other wells (the Long Road in our study) had not been repaired since we saw it in 2012, though maintenance was certainly overdue. The 2012 report discussed the Long Road at length including the detours created due to drainage issues.[36]

The road issue is important. It shows a failure in the construction/maintenance guidelines of the Office's *West Virginia Erosion and Sediment Control Field Manual*. This failure helps explain why well roads are also a significant percentage of citizen complaints to the Office.

We found the waterbar on the access road to 47-079-01492 (above 47-079-00731) damaged. Waterbars for the 47-079-01288 spur were also damaged. The road serving 47-079-00702 and 47-079-01314 is severely rutted, side ditches are filled with sediment, and near 47-079-00702 there is a giant wallow. (See our *Two Problem Wells* video.[37]) The short access spur from the state road at 47-097-03707 and 47-097-03708 (the Tall Trees horizontal Marcellus site) provides drainage from the pad. Site drainage is still inadequate, even with the 2012 improved drainage.

[35] See George Monk and Molly Schaffnit, 2009, *Environmental Assessment for 47-079-00731 and 47-079-01492, Putnam County, West Virginia*.

[36] George Monk and Molly Schaffnit, 2013, *Gas Well Study, 2012*, see Erosion and Sediment Control section beginning on page 9.

[37] http://youtu.be/FZe568nV45w.

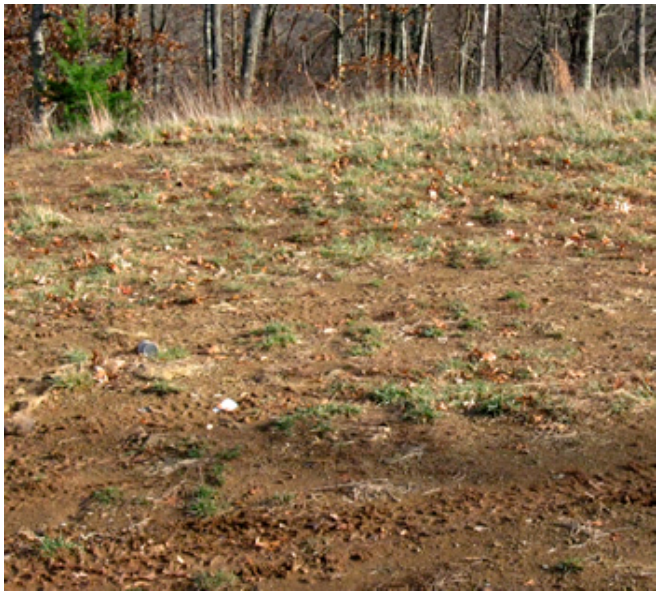

Photo 22. This is the portion of the pad for 47-079-01314 where we found contaminated soil at the former location of the pits. The vegetation is sparse here as it is over most of the pad. The Office's inspector in their report wrote about this well: "area has good vegetation." Photo taken on 18 November 2013.

Trash

Trash is another surface owner issue. The trash we found at sites had different sources. At 47-079-00702 it was not the operator's – the area outside the pad has become a casual dump. A gate at the site entrance would stop this.

At other sites trash was the operators' and included discarded pipe and equipment, including debris left at two plugged wells (47-039-02306 and 47-039-02319) in contravention of state law.[38] Pipe and other trash was also found at 47-039-01168, 47-079-00615, 47-079-00731 (the Office's report states this will be taken care of), and 47-079-00739. There was also an abandoned 100 barrel steel tank between 47-039-02306 and 47-039-02319 (confused in the Office's report with the tank at 47-039-02404 some distance away).

[38] See §22-6-30b: "Within six months after a well that has produced oil or gas is plugged, or after the plugging of a dry hole, the operator shall remove all production and storage structures, supplies and equipment, and any oil, salt water and debris, and fill any remaining excavations. . . ."

Other Issues

A number of problems noted in our 2012 study are aesthetic, such as unpainted metal at 47-079-00739. Some of these are maintenance issues related to well control. Small leaks seen at 47-039-01168 and 47-079-01492 were found at wells needing maintenance. Vegetation issues are both aesthetic and tied to sediment control. The poorly vegetated cut slope above the Tall Trees site (47-097-03707 and 47-097-03708) is a sediment control issue. Poor vegetation at 47-079-01314 is partially tied to contamination, as is the large bare area at 47-079-01492. We expect to find a site well grassed and with evidence of sediment control, even if the site is upland and not near surface water. The Office's report shows an extremely lax expectation for vegetation which is troubling.

A well site shouldn't look "wrong," an impression fostered by these less tangible aesthetic issues.

More importantly, the state, in allowing operators "fair use" of surface to access minerals, needs to decide if it wants to promote the destruction of a surface owner's property by contamination or by opening it up (because of unrestricted access created by a well) to trespass and hooliganism. And if the state wants to let operators trash the surface owner's property permanently, leaving debris behind after a well is plugged (as we found at 47-039-02319) or by pushing a portolet off into the woods away from the pad after drilling (as was done at 47-079-01314).

Specific Wells

Looking at specific wells, we didn't find in the Office's report that:

- Operator debris had been removed from plugged wells 47-039-02306 and 47-039-02319 as required by law.
- The abandoned steel 100 barrel tank we found in the woods between 47-039-02306 and 47-039-02319 is not the one mentioned in the Office's report. This tank appears to belong to either 47-039-01168, 47-039-02306, or 47-039-02319 and needs to be removed.
- Cranberry pipeline tank requires proper secondary containment.

- 47-079-00615 is an orphaned abandoned well that is producing. We can't understand why the Office doesn't shut the valve, chain and lock it, and post a sign telling the operator to contact the Office. The well is missing its API number, has trash, and the tank needs to be repaired or replaced and have proper secondary containment.

- At 47-079-00702 the tank has no rainwater drain. The site should be gated to prevent dumping. Restricting traffic might also improve vegetation on the mostly bare pad. Remains of a bonfire were seen in 2013 near the wellhead.

- At 47-079-00731 the well has the wrong API number (wrong county).

- At 47-079-01288 the site still has signs of contamination from buried pit waste. The road spur is in need of repair and vegetation on the site needs to be improved.

- At 47-079-01314 the well now has the correct API number. There is no rainwater drain for the secondary containment. The road and spur are in poor condition. Side ditches for the spur were filled with sediment. The site is contaminated by buried pit waste producing high soil chloride (536 ppm). Condition of the poorly vegetated pad was confirmed in November 2013, though the 2012 evidence of exposed pit liner had been removed.

- 47-079-01492's access road's water bar which prevents sediment from entering the Pocatalico River is damaged. There's been a serious slip along the site's fill slope through the buried pit waste cell exposing waste and liner.

- The Tall Trees site (47-097-03707 and 47-097-03708) cut slope is poorly vegetated. Runoff from the pad leaves by access road spur. Drainage is still poor. A visit in July 2013 found standing water in the tanks' secondary containment which we've been told is not unusual.

- 47-097-03716's pad was mostly bare and a soil sample showed high chloride at 384 ppm. This is a concentration that we've found will inhibit/prohibit grass growth. The drill pit should be properly closed and filled; there's no reason to leave it open. The fence around the large impoundment needs to be maintained as does sediment control along the slope above the trout pond. There was no evidence of the operator's seeding the site, an important sediment control.

- 47-079-00739 does not appear in the Office's report and apparently was not inspected. The well has no API number and the wellhead is badly corroded because of lack of paint. We weren't able to confirm proper secondary containment for the tank because the site was overgrown.

Conclusion

Rather than summarizing findings in this year's report we want to make three points.

Tables showing the range of problems seen at well sites visited in 2013 are in Appendix 4 (page 27). Photographs and additional materials augmenting this report are also available online.[39]

The obviously single walled tank at 47-079-00615 is leaking and does not have secondary containment. Yet the Office on inspecting the site reports "double-walled tank looked o.k." This calls into question the safety of the 57,000 gallon tank at the Tupper's Creek commercial UIC class 2 well (47-039-02210), also "double walled."

The permit for the commercial UIC class 2 well 47-019-00460 was given on 6 February 2014 while this report was in preparation. Like its 2007 predecessor, this permit requires closing of the pits. An additional permit condition requires compliance with Consent Order 2008-15. The reader may wish to refresh their memory and reread the text about this well beginning on page 10 and examine Appendix 1 (on page 20). The granting of this permit and the Office's dealing with this operator (and other operators) show obvious deficiencies in compliance enforcement and the permitting process.

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Appendix 1
Consent Order 2008-15

Consent Order 2008-15 required samples taken from pits, the stream beside the pits and downstream twice a year. These samples were to be tested for pH, iron, manganese, chloride, sodium, barium, TPH GRO, TPH DRO, TPH ORO, TDS, BTEX and oil and grease (the order omits the requirement for TDS for samples taken from "the stream downgrade").

47-019-00460's operator's performance is shown on Table 1 which has sample dates, locations, if all substances were tested for, and if sampling fully complied with the Consent Order.

A 2009 letter to the operator from the Office documents a Consent Order compliance issue. No other correspondence was seen in the file relating to missing tests.

Note that the operator took samples just once in 2010 and that the 2011 samples were both collected in December. Note also that pit samples were taken only once in 2009 and 2012, not twice a year.

Photo 23. Appearance of stream running alongside pits and downstream at 47-019-00460's facility. Stream before reaching facility is clear and has low chloride. In this part of the stream a hydrocarbon scum rests on the surface of the water and chloride has tested as high as 301 ppm. Still from video shot by Beth Little of the West Virginia chapter of the Sierra Club in May 2013.

Table 1. Compliance with Consent Order 2008-15

Date	Locations	Complies with Order's substance list	Fully complies with Order
3/18/2009	Pit / Adjacent to Pit/ Downstream	Yes (missed TDS in downstream sample)	Yes
12/28/2009	Upstream / Midstream / Downstream	Yes	No (no pit sample)
12/7/2010	Upstream / Midstream / Downstream	Yes	No (no pit sample), plus missing second set of 2010 samples
12/6/2011	Upstream / Midstream / Downstream	No	No (no pit sample)
12/29/2011	Upstream / Midstream / Downstream	No	No (no pit sample)
1/6/2012	Upstream / Midstream / Downstream	No	No (no pit sample)
10/11/2012	Upstream / Downstream	Yes	No
12/11/2012	Pit	No	

west virginia department of environmental protection

Office of Oil and Gas
601 57th Street
Charleston, WV 25304
(304) 926-0450
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Joe Manchin III, Governor
Randy C. Huffman, Cabinet Secretary
www.wvdep.org

April 8, 2009

Danny E. Webb Construction, Inc.
Attn: Danny Webb
P.O. Box 515
Brenton, WV 24818

RE: Underground Injection Control (UIC) Permit
#2D0190460 / #2D0190508

Please note that the stream adjacent to UIC system and associated pits must be sampled twice a year for the following parameters:

1. pH
2. Iron
3. Manganese
4. Chlorides
5. Sodium
6. Barium
7. TPH (DRO, GRO, ORO)
8. TDS
9. BTEX
10. Oil and Grease

The sample results recently submitted for the stream did not show Total Dissolved Solids(TDS). Please correct for future sampling.

If you have any questions regarding this matter feel free to contact me at 304-926-0499, ext. 1653.

Sincerely,

James Peterson
Environmental Resources Specialist / Permitting

Promoting a healthy environment.

Appendix 2
Waste Samples Lab Results

Table 2. Samples from waste pits at UIC class 2 sites.

Substance	47-085-09669 2013	47-019-00460 2009	MCL/*SMCL*
pH	6.09	7.03	
Chloride	78,976 mg/l	36,200 mg/l	*250 mg/l*
TDS	127,566 mg/l	52,700 mg/l	
TSS	778 mg/l		
Surfactants	12.8 mg/l		
Aluminum	0.85 mg/l		*0.05 to 0.2 mg/l*
Arsenic	0.78 mg/l		0.01 mg/l
Barium	553 mg/l	223 mg/l	2 mg/l
Cadmium	ND		0.005 mg/l
Chromium	ND		0.1 mg/l
Iron	113 mg/l	47.1 mg/l	*0.3 mg/l*
Lead	ND		0.015 mg/l
Manganese	6.87 mg/l	5.43 mg/l	*0.05 mg/l*[a]
Sodium	26,900 mg/l	15,000 mg/l	[b]
Total Sulfates	250 mg/l		
Organics			
TPH GRO	23.7 mg/l	15.6 mg/l	
TPH DRO	ND	ND	
TPH ORO	20.9 mg/l	ND	
Benzene	0.1421 mg/l	0.0263 mg/l	0.005 mg/l
Ethylbenzene	0.0297 mg/l	0.061 mg/l	0.7 mg/l
Toluene	0.3129 mg/l	0.248 mg/l	1 mg/l
Xylene	0.4075 mg/l	0.316 mg/l	10 mg/l
Isotopes			
Radium 226	3,054 ± 358 pCi/l		Radium 226 and 228 combined 5 pCi/l
Radium 228	284 ± 51.6 pCi/l		

[a] The EPA's health advisory concentration for manganese is 0.300 mg/l. Manganese in drinking water is tied to severe IQ deficits for children.

[b] The EPA's health advisory concentration for sodium is 20 mg/l because some people with heart conditions require low sodium diets.

Table 3. Davis Horizontal Marcellus Well Flowback

Substance	Day 1	Day 5	Day 20	MCL/*SMCL*
pH	7.09	6.55	6.24	
Chloride	27,700 mg/l	67,300 mg/l	71,200 mg/l	*250 mg/l*
TDS	43,800 mg/l	84,000 mg/l	124,000 mg/l	
TSS	127 mg/l	193 mg/l	388 mg/l	
Surfactants				
Aluminum	<0.03 mg/l	<0.03 mg/l	0.14 mg/l	*0.05 to 0.2 mg/l*
Arsenic	0.0021	<0.4	<0.2	0.01 mg/l
Barium	0.121 mg/l	136 mg/l	238 mg/l	2 mg/l
Cadmium	<0.0002 mg/l	<0.08 mg/l	<0.01 mg/l	0.005 mg/l
Chromium	<0.001 mg/l	<0.3 mg/l	<0.05 mg/l	0.1 mg/l
Iron	0.083 mg/l	38.3 mg/l	82 mg/l	*0.3 mg/l*
Lead	<0.0002 mg/l	<0.4 mg/l	<0.4 mg/l	0.015 mg/l
Manganese	0.933 mg/l	7.15 mg/l	10.4 mg/l	*0.05 mg/l*[a]
Sodium	51.8 mg/l	21,400 mg/l	33,100 mg/l	[b]
Total Sulfates	11,400 mg/l	<500 mg/l	1,460 mg/l	
Organics				
TPH GRO	0.86 mg/l	39.8 mg/l	14.5 mg/l	
TPH DRO	72.6 mg/l	57.9 mg/l	20.0 mg/l	
TPH ORO				
Benzene	0.288 mg/l	1.350 mg/l	1.760 mg/l	0.005 mg/l
Ethylbenzene	0.0071 mg/l	<0.144 mg/l	0.052 mg/l	0.7 mg/l
Toluene	0.340 mg/l	2.140 mg/l	2.040 mg/l	1 mg/l
Xylene				10 mg/l
Isotopes				
Radium 226	147 ± 15.1 pCi/l	302 ± 21.6 pCi/l	621 ± 31.5 pCi/l	Radium 226 and 228 combined 5 pCi/l
Radium 228	33.0 ± 2.05 pCi/l	151 ± 10.1 pCi/l	416 ± 16.4 pCi/l	

[a]The EPA's health advisory concentration for manganese is 0.300 mg/l. Manganese in drinking water is tied to severe IQ deficits for children.

[b]The EPA's health advisory concentration for sodium is 20 mg/l because some people with heart conditions require low sodium diets.

Appendix 3

Office of Oil and Gas Investigation of Wells in *Gas Well Study, 2012*

west virginia department of environmental protection

Office of Oil and Gas
601 57th Street
Charleston, WV 25304
(304) 926-0450 fax (304) 926-0452

Earl Ray Tomblin, Governor
Randy C. Huffman, Cabinet Secretary
www.dep.wv.gov

September 20, 2013

DEP/OOG Investigation: George Monk Gas Well Study 2012

Site API# 39-01046

- Arrived at location on April 5, 2013
- Location looked to be in compliance
- No issues with access road or well site

Site API#39-1168

- Arrived at location on April 30, 2013
- Location looked to be in compliance
- Well in in production with meter set on location
- Company has worked access roads
- API Number is correct

Site API#39-01198

- Arrived at location on April 30, 2013.
- Location looked to be in compliance
- No issues with access road or well site

Site API# 39-01552

- Arrived at location on April 25, 2013
- Site well maintained and in compliance
- No problems encountered at site

Site API#39-02306

- Arrived at location on April 25, 2013
- Well is Plugged
- No problems encountered at site – in compliance

Site API#39-02319

- Arrived at location on April 25, 2013
- Well is Plugged
- No problems encountered at site

CRANBERRY TANK- Arrived at location on April 5, 2013
This tank is a double wall tank and does not require additional secondary containment

ABANDONED TANK- Arrived at location on April 5, 2013
This is an empty spare tank on the site at the well location 39-2204.

Site API#79-00615

- Arrived on location on June 24, 2013
- Well is abandoned
- Sit looked good with grass / vegetation growing – in compliance.
- Double walled tank looked o.k.

Site API#79-00702

- Arrived at location on July 10 8, 2013
- Double walled tank with tank dike.
- Sit looked good with grass / vegetation growing

Site API#79-00731

- Arrived on location on June 25, 2013
- Secondary containment but needs improvement / operator to repair.
- Some trash on location that operator stated they would remove.
- Company will work access road & paint well

Site API#79-1288

- Arrived on location on June 26, 2013
- Access road in good shape, no evidence of runoff /erosion
- Drains in good condition
- Area has good vegetation

Site API#79-01299

- Arrived on location on June 20, 2013
- Access road in good shape, no evidence of runoff /erosion
- Drains in good condition
- Area has good vegetation

Site API#79-01314

- Arrived on location on June 25, 2013
- Access road in good shape, no evidence of runoff /erosion
- Drains in good condition
- Area has good vegetation

Site API#79-01492

- Arrived on location on June 20, 2013
- Access road in good shape, no evidence of runoff /erosion
- Drains in good condition
- Area has good vegetation

Site API#97-03707

- Arrived on location on May 7, 2013
- There are no maintenance or trash issues at this site
- Drains are in good condition. Drainage /sediment control devices in place by order of EPA
- Area has good vegetation

Site API#79-3708

- Arrived on location on May 7, 2013
- There are no maintenance or trash issues at this site
- Drains are in good condition. Drainage /sediment control devices in place by order of EPA
- Area has good vegetation

Site API#79-03716

- Arrived on location on May 7, 2013
- Well was lost and plugged in May 2011, replacement well was to be permitted and drilled on same site.
- To reclaim and rebuild pits would create more environmental impact than to leave them open for the replacement well.
- The well was plugged and a swedge was put on the 7" casing to protect the threads until the monument could be set in place. Monument was set in place sometime after Monk photo was taken.
- There are no maintenance, drainage, or sediment control issues at this site – in compliance.

Appendix 4
Tables Showing Site Issues

Three tables below show issues for the sites we visited in 2013. Only three of the sites had fencing or other security measures to protect the public (Tall Tree site, 47-097-03707 and 47-097-03708; the Tupper's Creek UIC class 2 well, 47-039-02210; and the class 2 UIC well in the Plymouth Amherst WMA, 47-079-01452).

Sites in the tables are indicated by API number. Sites organized according to sections of this report are:

2013 Gas Well Workshop Field Trip
47-079-00615, 47-079-00746

Tall Trees Site
47-097-03707, 47-097-03708

Putnam County Sites
47-079-00748, 47-079-01286, 47-079-01324

UIC Class 2 Wells
47-039-02210, 47-079-01452

Table 4

API Number	Missing or Incorrect API Number	Lacking or Inadequate Secondary Containment for Condensate Storage Tanks
Putnam County		
47-079-00615	**X**	**X**
47-079-00702		**no rainwater drain**
47-079-00746		**X inadequate**
47-079-00748		
47-079-01286		**X**
47-079-01314		**no rainwater drain**
47-079-01324		**X**
47-079-01452		
Kanawha County		
47-039-02210		**? large tank**
Upshur County		
47-097-03707		
47-097-03708		

Table 5

API Number	Maintenance Issues	Trash	Leak or Spill
Putnam County			
47-079-00615	**X**	**X**	**X (tank)**
47-079-00702		**X**	
47-079-00746			
47-079-00748	**X**		**X casing head**
47-079-01286			
47-079-01314		**X**	
47-079-01324			
47-079-01452			
Kanawha County			
47-039-02210			
Upshur County			
47-097-03707	**water in containment**		
47-097-03708			

Table 6

API Number	Vegetation Issues	Drainage and Sedimentation Control	Road Issues
Putnam County			
47-079-00615			
47-079-00702	**X**	**X**	**X**
47-079-00746			
47-079-00748	**X**	**X**	**X**
47-079-01286			
47-079-01314	**X**	**X**	**X**
47-079-01324	**X**	**X**	**X**
47-079-01452			
Kanawha County			
47-039-02210			
Upshur County			
47-097-03707	**X**	**X**	
47-097-03708			