UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Windfall Oil and Gas, Inc
Brady Township
Clearfield County, Pennsylvania

Draft Permit PAS2D020BCLE

SUPPLEMENT TO THE STATEMENT OF BASIS

On November 7, 2012, the U.S. Environmental Protection Agency (EPA) Region III issued a public notice requesting comment on the proposed issuance of an Underground Injection Control (UIC) permit, PAS2D020BCLE, to Windfall Oil and Gas, Inc. (Windfall). Comments raised during the public comment period ending December 31, 2012, raised a significant number of seismicity related concerns. Pursuant to 124.14(b) EPA Region III is issuing a Supplement to the Statement of Basis for the Windfall permit, and is reopening the public comment period for 30 days. The purpose of the Supplemental Statement of Basis is to clarify how EPA Region III reviewed this UIC permit application to evaluate the potential for induced seismicity from the injection well, as well as risk to the well operations from naturally occurring seismicity. The reopening of the comment period is limited solely to this issue of seismic risk.

Scientists have long recognized that human activities, such as construction of dams and water reservoirs, mining and oil and gas production, can trigger seismic events, including those that are felt by humans. Under certain conditions, disposal of fluids through injection wells has the potential to cause induced seismicity. However, induced seismicity associated with brine injection is uncommon, as additional conditions necessary to cause seismicity often are not present. Seismic activity induced by Class II injection wells can potentially occur only where all of the following conditions are present: (1) there is a fault in a near-failure state of stress; (2) the fluid injected has a path of communication to the fault; and (3) the pressure exerted by the fluid is high enough and lasts long enough to cause movement along the fault line. In the United States, EPA Region III is aware of fewer than 10 documented cases of injection well-induced seismicity, in contrast to more than 30,000 wastewater disposal injection wells in operation. *Induced Seismicity Potential in Energy Technologies*, National Academy Press (prepublication draft), 2012, at p. 6. Scientists believe that injection can cause seismicity when the pore pressure (pressure of fluid in the pores of the subsurface rocks) in the formation increases to such levels as to overcome the frictional force that keeps a fault stable. Pore pressure increases with increases in the volume and rate of injected fluid.

EPA Region III reviewed the map of seismic events from 1938 through 2012, recorded by the United States Geologic Survey (USGS), in Clearfield County where the proposed well is located. The map indicates that such events are extremely rare. In addition, maps developed by the Pennsylvania Department of Conservation and Natural Resources also indicate that seismic events in the County are rare. The County is not located in a tectonically active area and although there are several geologic faults located within one-quarter mile of the injection well site, there is no geologic evidence that these faults provide a mechanism for the transmission of formation fluids or that the other conditions necessary to cause seismicity are present. Although there have been earthquakes that have been recorded in Clearfield County, as well as felt in the area, these were the result of seismic events that had their origins in other parts of the state or outside of the state's borders. What have been felt in the County are seismic waves that were transmitted through the bedrock from the epicenter of a seismic event located elsewhere.

The Huntersville Chert/Oriskany formation, the intended injection zone, has been a prolific producer of natural gas in this area since the late 1950s/early 1960s. The removal of both natural gas and brine from this formation has lowered the formation's pore pressure and has created available pore space (storage capacity) making this reservoir a good candidate for the disposal of fluids. Sites such as depleted oil and gas reservoirs can make excellent disposal zones, because in those cases, during injection, pore pressures may not reach the original levels, or in some cases, may not increase at all due to the relative volumes of injection versus extracted fluid. *Induced Seismicity Potential in Energy Technologies*, at p. 6. Furthermore, the draft permit limits the rate and the volume of the fluid to be injected, which limits the increases in pore pressure and thus the potential for seismicity.

Significant natural gas production has occurred near the fault structure where the injection well is proposed to be located. Evidence from gas production records indicates that gas production wells located within this fault block have produced significantly greater volumes of natural gas, than gas production wells located outside of the fault block. This gas well production history helps to illustrate that the displacement of the Huntersville Chert/Oriskany formation created by the fault, resulted in confinement of natural gas and formation fluids within the immediate fault block structure and that fluid flow across the faults is not evident. Because of the non-transmissive nature of the faults, fluid that is injected into the Huntersville Chert/Oriskany formation at the proposed injection well location should be confined within the fault block as long as injection pressure is maintained below a critical stress, such as fracture pressure.

To minimize conduits for fluid to potentially contaminate underground source of drinking water (USDWs), operating conditions in an injection well permit can expressly limit the injection pressure to prevent fracturing (or cracking of the rock) of the injection zone. Limiting injection pressure provides the secondary benefit of preventing fractures that also could act as conduits through which fluid could flow and act upon an existing fault. In order to induce seismicity,

pressure from the fluid injected would, first, have to be great enough to create or reopen fractures that would act as conduits for the fluid to reach the fault and second would have to exert enough pressure and flow to overcome the frictional forces in, and thereby destabilize, the fault. During the construction of a well, a completion process takes place whereby the operator obtains data on the amount of pressure necessary to fracture the formation and also determine the instantaneous shut-in pressure. Instantaneous shut-in pressure is the minimum pressure necessary to begin to re-open fractures created during the fracturing process. This pressure is significantly lower than the fracture pressure. EPA Region III used instantaneous shut-in pressure from gas production wells located near the proposed Windfall well location as a basis to establish the maximum injection pressure for this permit, to thus prevent the re-opening of any existing fractures or the creation of new fractures in the receiving formation. If the Windfall well is drilled, similar data as discussed above will be obtained and used to compare with the data used to develop the maximum injection pressure. If necessary, the permit's maximum injection pressure would be adjusted accordingly based on the data from the Windfall well.

Of the hundreds of thousands of injection wells operating in the United States, EPA Region III is not aware of any case where a seismic event, whether naturally occurring or induced, caused an injection well to contaminate a USDW. EPA Region III is also unaware of any studies that have been done specifically to determine whether injection wells have caused contamination of a USDW during a seismic event. Region III consulted with other regional personnel in EPA and found no examples of mechanical integrity failure during seismic events, or contamination from injection wells due to an earthquake. In any case, the Windfall permit will require continuous monitoring for pressure and flow rate. If a seismic event were to occur that affected the operation and mechanical integrity of the Windfall injection well, the well will be designed to automatically detect a failure due to pressure changes in the well and this would cause the well to stop operating (i.e., the well would automatically be "shut-in").