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

STATEMENT OF BASIS

U.S. EPA UNDERGROUND INJECTION CONTROL (UIC)
DRAFT CLASS IID PERMIT REISSUANCE VAS2D697BDIC

FOR

ENERVEST OPERATING, LLC
809 HAPPY VALLEY DRIVE
CLINTWOOD, VA 24228

FOR

A project consisting of one Class IID injection well used for the disposal of produced fluids (brine) associated with coal bed methane and conventional gas production located at:

Well VWD-539572
Nora Field, Cane Creek area
Dickenson County, Virginia

On July 30, 2018, EnerVest Operating, LLC ("EnerVest" or "the Permittee") submitted a UIC application for the reissuance of a permit that would allow for the construction and operation of a class IID brine disposal injection well located in the Nora Field, near Cane Creek, Ervinton District of Dickenson County, Virginia. The coordinates for this Injection Well are: Latitude 37º 04' 13" and Longitude 82º 10' 26". EPA Region III staff reviewed this application and requested additional information from EnerVest on August 14, 2018. In response to EPA's request, the Permittee supplemented the original permit application on November 28, 2018. After review of this additional information, EPA deemed EnerVest's permit application complete on December 17, 2018. The Permittee's July 30, 2018 and November 28, 2018 submittals are collectively referred to in this Statement of Basis as the "permit application".

Equitable Production Company of Pittsburgh, PA held the previous permit for the construction and operation of this injection well, effective on November 4, 2008 for a period of 10 years. On January 14, 2015 the permit was transferred to Range Resources of Abingdon, VA. The permit then was transferred to EnerVest on January 14, 2016. Construction of the injection well was never initiated. That previous permit expired on November 4, 2018.

Pursuant to the federal Safe Drinking Water Act, 42 U.S.C. §§ 300f *et. seq.*, and its implementing regulations, 40 C.F.R. Parts 144-146, and § 147.235, the EPA UIC Program is responsible

for regulating, through the issuance of permits, the construction, operation, monitoring and closure of injection wells that place fluids underground for disposal or enhanced recovery in oil and gas production. Today's draft permit specifies conditions for injection well construction, operation, monitoring, reporting, and plugging and abandonment which are specified to protect, and prevent the movement of fluids into Underground Sources of Drinking Water (USDW). The Permittee's UIC project and the draft permit conditions specific to the project are described below:

Area of Review: Pursuant to the applicable regulations, 40 C.F.R. §§ 144.3 and 146.6(b), the "Area of Review" is an area surrounding the Injection Well, which the applicant must first, research, and then develop a program for corrective action to address any wells that penetrate the injection zone and which may provide conduits for fluid migration during the injection operation. EnerVest proposed a fixed radius Area of Review of one-quarter mile which EPA determined is acceptable. In determining the fixed radius, EPA has considered the following information provided by the Permittee: chemistry of injected and formation fluids; hydrogeology, population and ground-water use and dependence; and historical practices in the area. EnerVest has provided documentation on the fluid to be injected, the ground-water use in the area, and on the well population within the one-quarter mile Area of Review. The injectate is compatible with the formation as evidenced by successful use of the Weir formation by other EPA-permitted injection wells within the Nora Field. There are no drinking water wells within half mile radius of the injection well. The Permittee did indicate that there are two coal-bed methane wells within the Area of Review; however, these wells don't penetrate the injection zone. There were also no plugged wells or unplugged/abandoned wells within the Area of Review. If any unplugged/abandoned wells that penetrate the injection zone are found within the Area of Review at a later date the draft permit requires the Permittee to perform corrective action.

Underground Sources of Drinking Water (USDW): An USDW is defined by the UIC regulations as an aquifer or its portion which, among other things, contains a sufficient quantity of ground water to supply a public water system and which also contains fewer than 10,000 mg/L (milligrams per liter) Total Dissolved Solids, and which is also not an exempted aquifer. The Permittee reviewed the drilling information for a nearby UIC well operated by EnerVest and reported encountering fresh water at 64 and 96 feet below ground surface. The drilling reports also recorded a damp zone at 395 feet below ground surface, however, no measurable flow was recorded. A daily report for two coal-bed methane wells within the ¼-mile Area of Review showed a wet zone at 604 feet below ground surface with no measurable flow and a fresh water zone at 615 feet below ground surface. The daily report also showed a wet zone at 1,560 feet below ground surface with no measurable flow. Therefore, EPA has determined the lowermost USDW to be located at 615 feet below ground surface. The proposed construction of the Injection Well will comply with the regulations at 40 C.F.R. § 147.1955(b), which require installing surface casing from the surface to a depth of at least 50 feet below the base of the lowermost USDW and cementing that entire length of casing back to the surface. EnerVest will set the surface casing for the Injection Well at an approximate depth of 708 feet below ground surface and cement the casing back to the surface. EnerVest will also install intermediate tubing to an approximate depth of 2,041 feet below ground surface and cement it back to the surface to further protect groundwater.

Injection and Confining Zones: The draft permit limits injection of fluids for disposal to the Lower Mississippian Weir Sand formation in the subsurface interval between, approximately, 5,127 to 5,183 feet below ground surface. The lowermost USDW is separated from the injection zone by approximately 4,512 feet. The Mississippian Big Lime formation, a dense carbonate (limestone) and shale that's approximately 750 feet in thickness is located immediately above the Weir formation injection zone.

Injection Fluid: The draft permit limits the injection fluids in these wells to treated fluids produced from EnerVest Virginia operations' conventional and coalbed methane wells. The draft permit also establishes a maximum daily injection volume of 45,000 barrels per month. One barrel of fluid is equal to 42 gallons.

The permit application includes analyses of the injection fluid that corresponds to the requirements stated in Paragraph II.C.3. in the draft permit. The parameters chosen for sampling reflect not only some of the typical constituents found in the injection fluid, but also in shallow ground water. Should a ground water contamination event occur during the operation of the Injection Well, EPA will be able to compare samples collected from groundwater with the injection fluid analysis to help determine whether operation of the Injection Well may be the cause of the contamination.

Maximum Injection Pressure: The maximum allowable surface injection pressure for the permitted operation has not been determined yet. The Permittee is required by Paragraph III.A.3. in the draft permit to complete a formation testing program after construction of the well to establish a fracture gradient developed by using the instantaneous shut-in pressure (a pressure lower than the fracture pressure). The maximum pressure is then developed using the depth to the Weir formation injection zone, the specific gravity of the injected fluid (1.10), and the fracture gradient. Within a quarter-mile of the proposed wellbore is another EnerVest-operated, EPA-permitted injection well with a maximum allowable injection pressure of 1215 pounds/square inch (psi). Because that injection well also injects into the Weir formation, the maximum pressure for the proposed well may be similar.

Potential for Seismicity: The SDWA regulations for Class II wells do not require consideration of the seismicity, unlike the SDWA regulations for Class I wells for the injection of hazardous wastes. See regulations for Class I hazardous injection wells at 40 C.F.R. §§ 146.62(b)(1), 146.68(f). Nonetheless, because of public concerns about injection-induced seismicity, EPA evaluated factors relevant to seismic activity as discussed below and addressed more fully in *"Region 3 framework for evaluating seismic potential associated with UIC Class II permits"*. EPA will also establish a maximum injection pressure which is designed to limit the potential for seismic events.

The region in which the Facility will be located consists of an extensive, thick, sedimentary sequence with numerous confining strata between the surface and the proposed injection zone.

The permit provides that the Permittee shall inject through the Injection Well only into a formation which is overlain by a confining zone free of known open faults or fractures within the Area of Review as required in 40 C.F.R. § 146.22. The Permittee submitted geologic information that indicates the absence of faults within a one-mile radius of the Injection Well. Additionally, the entire Appalachian Plateau, on which the Facility will be located, is considered geologically stable with no active faults.

The available geophysical and seismic information researched by the Permittee, as well as through EPA's review of published information of seismicity in Virginia shows no evidence of faults that reach the land surface from basement rock. More information can be found on a website about Earthquakes from the Virginia Department of Mines, Minerals, and Energy, Division of Geology and Minerals (http://www.dmme.virginia.gov/dgmr/earthquakes.shtml). The geologic information does identify the presence of the Russell Fork Fault, which is a right-lateral fault located nearly 3.1 miles southwest of the Injection Well. The fault is transcurrent and is believed to have a lateral displacement of up to six miles. Movement along this fault occurred several million years ago and was due to regional compression (sediment deposition). Geophysical well logs from wells which penetrate the injection zone located on

either side of the suspected surficial fault document that there has been minimal relative displacement or movement of the deeper injection and confining zones across the fault area.

Geological information shows that the Appalachian Basin, including southwestern Virginia, which lies on the passive continental margin, is not currently seismically active because insufficient pressure exists to cause movement along ancient faults and fractures. These faults and fractures are closed and non-transmissive due in large measure to the tremendous downward pressure exerted by thousands of feet of overlying sediment deposited since their creation.

The United States Geologic Survey (USGS) has not recorded any seismic activity that originated in Dickenson County, Virginia from 1900 through present day (USGS: "Information by Region-Virginia-All Earthquakes 1900-Present" : http://earthquake.usgs.gov/earthquakes/byregion/virginia.php). Virginia is located near the center of the North American Plate, thus experiences a much lower rate of seismicity in comparison with an area like California, which is located closer to a plate boundary and experiences shallower, more energetic seismic events due in part to less coherency in the basement rock. Additionally, California earthquakes often break the ground surface, while earthquakes in Virginia usually occur on faults at depths from three to fifteen miles below the ground surface. The rare earthquakes felt in Virginia today generally have no relationship with faults seen at surface. Residual stresses from the formation of the Appalachian Range and the Piedmont province hundreds of millions of years ago appear to be the mechanism for Virginia's earthquakes. Earthquake activity in Virginia has been associated with basement rock, either form basement faulting or faulting at a shallower depth caused by tectonic stresses that originated from the basement rock.

The permit will include injection pressure limits to prevent the initiation or propagation of fractures that could create conduits for the injected fluid to flow to any existing faults. EnerVest is required by the draft permit to develop a formation testing program in order to establish an instantaneous shut-in pressure (ISIP). The ISIP is the minimum pressure necessary to begin to reopen any fractures created during the fracture stimulation process and is significantly lower than the pressure required to fracture the rock. EPA will limit the surface injection pressure and the bottom-hole pressure to be less than both the ISIP and the fracture pressure to prevent the initiation of new, or the propagation of existing, fractures.

Finally, a number of factors help to prevent injection wells from failing in a seismic event and contributing to the contamination of a USDW. Most Class I or Class II injection wells, including this Injection Well, are constructed to withstand significant amounts of pressure. The EnerVest Injection Well will be constructed with multiple steel rings of casing that are cemented in place. Furthermore, both the existing and the draft Permits require EnerVest to mechanically test the Injection Well to ensure integrity before operations begin and continuously monitor the Injection Well during operations to detect any potential mechanical integrity concerns. The Injection Well is also designed to automatically shut-in and cease operation in the event that the mechanical integrity of the well is compromised, including by a seismic event.

Testing, Monitoring and Reporting Requirements: The Permittee is required to conduct a mechanical integrity test (MIT) after construction of the Injection Well. The MIT consists of a pressure test to make sure the casing, tubing and packer in the well does not leak and a fluid movement test, through the review of cementing records and a cement bond log or a temperature log to make sure that movement of fluid does not occur outside of the injection zone. In addition to the monitoring described above,

additional pressure testing of the casing, tubing and packer will occur every five years and whenever a rework on the well requires the tubing and packer to be released and reset.

The Permittee will be responsible for continuously monitoring the injection well for surface injection pressure, flow rate and cumulative volume beginning on the date which the injection well commences operation and concluding when the injection well is plugged and abandoned. The Permittee must submit an Annual Report to the EPA Director summarizing the results of the monitoring required by the draft permit, including monthly monitoring records of the injection fluid, the results of any mechanical integrity testing and any major changes in the characteristics of the injected fluid. The annual report must be submitted to EPA by January 31 of each year and report the previous calendar year information.

Plugging and Abandonment: The Permittee has submitted a plugging and abandonment plan that will result in an environmentally protective well closure at the time of cessation of operations. The Permittee has not yet demonstrated financial responsibility for adequate financial resources for well closure. Prior to authorization to inject, the Permittee must secure a Performance Surety Bond along with a Standby Trust Agreement to ensure proper plugging of the Injection Well. The amount of the Performance Surety Bond shall cover the estimated cost to close, plug and abandon the Injection Well in the amount of at least $35,000. The amount of the Performance Surety Bond is based on an independent third-party estimate for the cost of plugging and abandonment of the injection well. This should preclude the possibility of abandonment without proper closure.

Expiration Date: When issued, a final permit will be in effect for ten years from the date of the permit effective date. EPA will conduct an annual review of the Permittee's operation. The final permit will contain essentially the same conditions of this draft permit unless information is supplied to EPA which would warrant alternative conditions or actions on this permit application.

Additional Information: The Administrative Record for the draft permit is available for public inspection during normal business hours at the offices of U.S. EPA Mid-Atlantic Region, at the address shown below. All information submitted by the applicant in support of the draft permit, unless deemed confidential, is included in the Administrative Record for the permit and is available to the public for review. Copies of permit applications, the draft permit, the statement of basis, and the administrative record index are available for review and inspection at the Jonnie B. Deel Memorial Library which is located at 198 Chase Street, Clintwood, VA 24228. Please direct any questions, comments and requests for additional information to the contact person listed below. EPA has tentatively scheduled a public hearing for June 25, 2019, 6:00 PM at the Dickenson County Judicial Center located at 119 Courthouse Lane, Clintwood, VA 24228. **Requests to hold this public hearing must be received by June 7, 2019**. When requesting a public hearing, please state the nature of issues you propose to raise. EPA expressly reserves the right not to hold a hearing unless a significant degree of public interest is evidenced on the proposed injection operation**. The Administrative Record for this action will remain open for public comment until June 14, 2019.**

Submit comments or requests for a hearing or for additional information to:

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