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

Response to Comments
for
The Issuance of an Underground Injection Control (UIC) Permit
for
Penneco Environmental Solutions, LLC

On June 22, 2017, the U.S. Environmental Protection Agency Region III (EPA or the Region) issued a public notice in the Pittsburgh Tribune-Review requesting comment and announcing the opportunity for a public hearing for the proposed issuance of an Underground Injection Control (UIC) permit, PAS2D701BALL, to Penneco Environmental Solutions, LLC (Penneco) for one Class II-D underground injection well. EPA received numerous requests for a hearing which was held on July 26, 2017 at the Plum Community Center in Plum Borough, Pennsylvania. About 200 people attended the public hearing and EPA received oral comments from people in attendance at the hearing. At the hearing, EPA extended the public comment period until August 9, 2017, and invited the submission of any additional written comments. In total, EPA received approximately 400 comments from over 120 people. During the public comment period, all the information submitted by the applicant was available for review at the Plum Community Library in Plum Borough and at the EPA regional office in Philadelphia and online at the EPA web site.

The response to comments and questions which follows consolidates and provides responses to questions and issues raised by people who sent timely written public comment during the public comment period and who provided oral comments at the public hearing. EPA wishes to thank the public for their informative and thoughtful comments and to thank the people from the Plum Community Center and Public Library that assisted EPA in hosting the public hearing.

1) What does the EPA UIC program have jurisdiction and authority to regulate?

Many people raised concerns about matters that the EPA UIC program does not have the jurisdictional or regulatory authority to address in the UIC permitting process. Some of the concerns mentioned were the potential for increased truck traffic, damage to the roads, increased noise, the potential for the diminishment of property values, and the possibility of surface spills and runoff into nearby streams and rivers. Additional public comments which related to the origin of the brine, proximity to watersheds and streams, emergency response capabilities, nearby drinking water treatment facilities, alternative waste disposal options, and compensation to the local community, while legitimate, are also outside the Federal UIC permitting process and are commonly addressed by State and local regulations. For example, Commonwealth of Pennsylvania oil and gas laws and regulations found at 25 Pa. Code Chapter 78 and 78A "Environmental Protection Standards at Oil & Gas Well Sites", comprehensively address surface activities and industry practices at oil and gas well sites. These oversight activities include water

supply protection, site specific Preparedness, Prevention and Contingency Plans for well site waste management, and secondary containment and corrosion control for storage tanks.

When making the decision on whether to issue a UIC permit for Penneco, EPA's UIC jurisdiction is limited to determining whether the proposed injection operation will safely protect underground sources of drinking water (USDWs) from the subsurface emplacement of fluids and a determination that the injection operation as proposed will be in compliance with all federal underground injection control regulations. A USDW, as defined in the UIC regulations at 40 C.F.R. § 144.3, is an aquifer or its portion with less than 10,000 mg/l Total Dissolved Solids (TDS) and which currently supplies a public water supply or contains sufficient quantity of ground water to supply a public water supply.

Although the concerns described above may be relevant to residents, unless they are related to the protection of USDWs or compliance with the regulations, EPA is not authorized under the SDWA to address them through the UIC permitting process. Other local, county, state or federal ordinances or regulations may address traffic, road noise, zoning concerns, surface spill prevention and other issues raised by these commenters.

The UIC permit contains several conditions that address compliance with other local, state or federal laws. Part I.A. of the permit provides that "Issuance of this permit does not convey property rights or mineral rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, an invasion of other property rights or any infringement of state or local law or regulations." In addition, Part I.D.12 of the permit states, "Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation." The operator must also receive a permit from the Pennsylvania Department of Environmental Protection (PADEP) prior to initiating construction, conversion and operation of the injection well. Therefore, EPA's UIC permit is only one of several authorizations that a permittee may be required to obtain before it is authorized to commence construction and/or operation of the injection well.

2) Do the UIC regulations supersede local land use plans?

As referenced in response number (1), EPA requirements do not supersede local, county or state laws or regulations.

3) The EPA public participation requirements for this UIC permitting action were not adequate. EPA was criticized for failure to return telephone calls during the comment period.

40 CFR § 124.10 specifies the requirements for public notice, public comment, opportunity for public hearing and other administrative aspects of the UIC permitting process. As referenced previously, a public notice was placed in a local newspaper of significant circulation, requests for a public hearing were received, a hearing was held, and the public comment period was extended based upon the level of public interest. The permit application including all addendums, the draft permit, and the statement of basis were available for public review pursuant to UIC regulations. Some telephone calls to the Region went unreturned during

the thirty-day comment period in advance of the hearing due to unexpected volume. The messages left requested EPA hold the public hearing as scheduled. The need for a public hearing was apparent due to significant public interest.

4) EPA should require the operator to find another location for disposal.

EPA does not have the jurisdictional authority to require operators to construct an injection well in any particular geographic location. The location chosen by an operator is based on many factors such as: economics, property ownership and accessibility, and geologic suitability. Depleted oil and gas producing formations are frequently targeted for brine disposal. The Murrysville Sand Formation has a long history of natural gas production in southwest Pennsylvania. According to a recent publication of the National Energy Technology Laboratory, **Development of Subsurface Brine Disposal Framework in the Northern Appalachian Basin**, injection simulations generally suggest there is little potential for brine migration due to relatively low injection formation permeability and little contrast in fluid densities between the injected fluid and existing formation fluid. The Murrysville Sand formation was included in this analysis. EPA's statutory and regulatory responsibility is to review each UIC permit application it receives to determine whether USDWs will be protected from the proposed injection well operation and whether the operation will be in compliance with the UIC regulations. Hence, EPA cannot deny a permit solely because of residents' opposition to the location, if the applicant otherwise meets the requirements of the UIC program.

5) Widespread surface and shallow underground coal mining in the area preclude injection well siting.

Many of the oil and natural gas production wells in Allegheny County penetrate coal seams, coal mines or mine pillars. 25 Pa. Code Chapter 78 Sections 78.83 (g) and (h) address construction requirements for wells which penetrate coal seams for the purpose of protecting coal resources. In some instances, the coal protection string of casing in a well may be the same as the fresh water or surface casing string. The UIC program considers shallow coal seams and mines, including the Pittsburgh and Upper Freeport seams in Allegheny County to be USDWs. Even though these aquifers may not now serve as water supplies, they may in the future. For this reason, UIC well construction and operating requirements are premised upon protecting these zones from fluid migration or other impacts. The Sedat Well #3A has 643 feet of coal and fresh water protective casing in the well which is cemented to the surface.

6) The injection well construction standards and the well monitoring and testing procedures specified in the application and permit are insufficient. One commenter concluded that the proposed monitoring well is not adequate.

The Sedat Well #3A has a 9 5/8-inch diameter string of ground water protective surface casing running from 643 feet to the surface. This exceeds the technical and generally accepted criteria of surface casing placement at no less than 50 feet below the lowermost USDW. See EPA, "Cementing Records Requirements in Direct Implementation Programs to Achieve Part II of Mechanical Integrity in Class II Injection Wells" (Jan. 27, 1999).

(https://www.epa.gov/sites/production/files/2015-08/documents/cementing_records_requirements_in_direct_implementation_programs_to_achieve_part_ii_of_mechanical_integrity_in_class_ii_injection_wells.pdf).

The permit application also documents that the Sedat Well #3A well has 7-inch diameter, long string casing cemented from a depth of 1,948 feet to the surface as required by 40 C.F.R. § 147.1955(b)(5). Fluid will be injected via a 4-inch diameter, injection string set on a packer. The USDWs will be protected by three layers of casing and cement.

The Permittee is required to conduct a two-part mechanical integrity test (MIT) prior to well operation. The two-part MIT consists of a pressure test to make sure the casing, tubing and packer in the well do not leak, and a fluid movement test to make sure that movement of fluid does not occur outside the injection zone. In addition to the monitoring described above, additional pressure testing of the casing, tubing and packer will occur every two years or whenever a rework on the well requires the tubing and packer to be released and reset. The Permittee will be responsible for monitoring injection pressure, annular pressure, flow rate and cumulative volume on a continuous basis and reporting this data to EPA on an annual basis. These tests as well as monitoring and cementing records, will provide documentation as to the absence of fluid movement into or between USDWs and define flow conditions that exist in the injection zone during operation, thus assuring that USDWs are protected.

In addition to these monitoring and testing requirements, the Permittee has identified one well, Pennsylvania permit number 003-21210, which will serve as a monitoring well. The purpose of this well is to monitor formation pressure in the injection zone and alert the Permittee of the potential for fluid movement out of the injection zone. The monitoring well is not intended to detect plume movement as would be the case for monitoring a shallow water table aquifer. The Permittee notes in their application that the monitoring well is 1,010' to the southwest of Sedat Well #3A and has satisfactory spacing and placement to provide adequate formation pressure monitoring.

7) The one-mile radius around the proposed property boundary is insufficient and the required information within this area is missing from the maps in the applications, including abandoned coal mines and gas production wells.

UIC regulations at 40 C.F.R. § 144.31(e)(7) require the submission of a topographic map extending one mile beyond the property boundary, showing the location of the injection well or project area for which the permit is sought. Pursuant to those regulatory requirements, the map must depict the facility and each of its intake and discharge structures; each of its hazardous waste treatment, storage, or disposal facilities; each well where fluids from the facility are injected underground; and those wells, springs, and other surface water bodies, and drinking water wells listed in public records or are otherwise known to the applicant. In addition, the map must depict active and abandoned mines, quarries and other pertinent surface features including residences and roads, and faults, if known or suspected within one mile of the proposed injection well. The applicant provided several maps, including topographic maps, with these items included and a list of the property owners and their mailing address.

8) The wells in the Area of Review were not thoroughly evaluated. The method and data used for calculating the Zone of Endangering Influence and the Area of Review is questionable.

40 C.F.R. §§ 144.3 and 146.6(b), defines the Area of Review (AOR) as "the area surrounding an injection well described according to the criteria set forth in § 146.06..." 40 C.F.R. §§ 144.3. Section 146.06 provides that the area of review for each injection well shall be determined according to either the zone of endangering influence (ZEI) or by a fixed radius. Penneco proposed a fixed radius of ¼-mile (1,320 feet) for the AOR and a maximum injection volume of 54,000 barrels per month.

EPA does not specify a method for determining porosity and permeability because there is more than one accepted method for determining such values. Based on the information provided and other relevant data, EPA calculated the zone of endangering influence (ZEI) in accordance with 40 C.F.R. § 146.6(a)(2) using the modified Theis equation and confirmed the adequacy of the ¼-mile fixed radius AOR. This evaluation also considered the chemistry and specific gravity of the fluids to be injected, proposed injection pressures and volumes and the injection formation permeability and porosity. EPA confirmed, based on the ZEI calculation, that the ¼-mile fixed radius AOR was acceptable.

The applicant must then research and then develop a program for corrective action to address any wells which penetrate the injection zone and which may provide conduits for fluid migration within the AOR. Penneco provided information on the well population within the AOR by conducting reviews of Pennsylvania Department of Environmental Protection Bureau of Oil and Gas well records and conducting a field survey of the area. After extensive research of company, local, county and state well records, five wells were identified that penetrate the injection zone within this AOR. Additionally, detailed well completion records were evaluated for approximately 60 wells which penetrate the injection zone within a one-mile radius. The permit requires Penneco to perform corrective action on any unplugged/abandoned wells that penetrate the injection zone within the Area of Review if they are identified at a future date.

9) Abandoned or improperly plugged gas wells may pose a risk to drinking water supplies within the ¼-mile Area of Review (AOR). The volume and pressure of injected fluid is excessive. One commenter provided a copy of a report by Ingraffea et al. in the Proceedings of the National Academy of Sciences titled, "Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000-2012".

The National Academy of Sciences report cited above concludes that casing and cement impairment in oil and gas wells can lead to methane migration and USDW contamination. All wells within the AOR potentially influenced by the Penneco injection operation have been thoroughly evaluated to document proper well construction and/or plugging and abandonment. EPA agrees that, without certain precautions, abandoned wells **can** pose a risk to USDWs by providing a conduit for the migration of fluid out of an injection zone. Therefore, the UIC regulations and the permit impose certain requirements on the injection well operator to protect USDWs from that risk. Specifically, as detailed in 7) previously, the operator is required to

determine whether any abandoned wells exist within a specified area, calculated and defined as the AOR around the proposed well, which could pose a threat to USDWs. If abandoned wells are found to exist within a ¼-mile AOR, then the permittee must either perform corrective action, which requires plugging those wells, or use the abandoned wells for monitoring the injection formation during operation. When abandoned wells found within the AOR have been plugged as verified by a certificate of plugging which is submitted to the PADEP, EPA accepts this information as confirmation that a well has been plugged properly in accordance with PADEP plugging requirements which were in effect at the time the well was plugged.

EPA developed the maximum injection pressure for the injection well using data specific to Sedat Well #3A submitted by Penneco in the permit application. Penneco provided to EPA fracture stimulation data obtained by HFrac Consulting Services, LLC that included 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 limited in the draft permit the surface injection pressure and the bottom-hole injection pressure to a level lower than both the ISIP and the fracture pressure to prevent the initiation of new or the propagation of existing fractures. Additionally, EPA evaluated a Master's Degree thesis by West Virginia University graduate student Melissa L. Sager titled, *Petrologic Study of the Murrysville sandstone in Southwestern Pennsylvania*, 2007. This report details the reservoir characteristics of the Murrysville Sand and characterizes the permeability as generally high throughout the formation. These formation characteristics, well construction requirements, operational parameters and well monitoring are conducive to injecting 54,000 barrels per month at a maximum well head injection pressure of 1,421 psi as proposed.

10) Injection wells may increase seismic activity which could cause fluid migration and USDW contamination and mine subsidence. One commenter specifically referenced as problematic, the proximity of the proposed injection well to the Blairsville-Broadtop (Mahoning River) Lineament.

EPA must consider appropriate geological data on the injection and confining zones when permitting Class II wells. The SDWA regulations for Class II wells do not require specific consideration of seismicity, unlike the SDWA regulations for Class I wells used for the injection of hazardous waste. See regulations for Class I hazardous waste injection wells at 40 C.F.R. §§ 146.62(b)(1) and 146.68(f). Nevertheless, EPA evaluated factors relevant to seismic activity such as the existence of any known faults and/or fractures and any history of, or potential for, seismic events in the area of the injection well as discussed below and addressed more fully in *"Region 3 framework for evaluating seismic potential associated with UIC Class II permits, updated September, 2013."*

An EPA report that looks at injection-induced seismicity ("Minimizing and Managing Potential Impacts of Induced-Seismicity from Class II Disposal Wells: A Practical Approach," EPA UIC National Technical Workgroup, February 5, 2015[1]) provides a standard operating procedure for assessing regional and local seismicity when reviewing permit applications. This procedure correlates any area seismicity with past injection practices; evaluates geological

[1] The EPA UIC Technical Workgroup finalized this report on February 5, 2015 at EPA Headquarters.

information to assess the likelihood of activating any faults; evaluates storage capacity of the formation with consideration of porosity and permeability; includes operational parameters to limit injection rate and volume and to limit operation at below fracture pressure; and requires monitoring of injection pressure and rates.

Induced seismicity background

Under certain conditions, disposal of fluids through injection wells has the potential to trigger seismicity. However, induced seismicity associated with brine injection is uncommon, as conditions necessary to trigger seismicity often are not present. Seismic activity induced by Class II wells is likely to 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 allow movement along the fault line (*Induced Seismicity Potential in Energy Technologies*, National Academy Press, 2013, at p. 10-11). Although there are approximately 30,000 Class II-D brine wastewater disposal wells operating in the United States, only a few of these wells have been documented to have triggered earthquakes and none of these earthquakes, which the Region is aware of, has caused injected fluids to flow into or contaminate a USDW.

The presence of a fault in a receiving formation potentially creates a more vulnerable condition for a future seismic event. A fault is a fracture or a crack in the rocks that make up the Earth's crust, along which displacement has occurred. Where a fault is present near an injection site, scientists believe that injection can trigger 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 the fault stable. Pore pressure increases with increases in the volume and rate of injected fluid. Thus, the probability of triggering a significant seismic event due to injection, where the injection fluid reaches an active fault, increases with the volume and the rate of fluid injected. In addition, the larger the volume injected over time, the more likely a fault could be intersected, because the fluid will travel farther within a formation. When injected fluid reaches a fault, frictional forces that have been maintained within that fault can be reduced by the fluid. At high enough pore pressure, the reduction in frictional forces can result in the formation shifting along the fault line, resulting in a seismic event.

Because increases in pore pressure due to the rate and the volume of injected fluid can act on existing faults and provide a mechanism for induced seismicity, most examples of injection-induced seismicity are in cases where the receiving formation has low permeability and/or the pressure or volume of fluid injected over time is quite large. Formations such as crystalline basement rock (deeper geological formations of igneous or metamorphic rock that underlie layers of sedimentary rock) have very low permeability. Permeability is the ease with which a fluid can flow through the pores in a rock layer. Where permeability is low, injected fluid cannot flow easily through the pores in this rock and therefore flow is oriented mainly through existing fractures or faults in the rock (secondary permeability). These kinds of rock formations have high transmissivity and low storativity. This means that the formation cannot store a lot of fluid; rather fluid moves farther and faster in these formations than in more porous formations. Because of the high transmissivity and low storativity of these rock types, the potential exists to induce pore pressure increases at considerable distances away from the injection well.

Faults near the proposed well

The UIC regulations at 40 C.F.R. § 146.22 require that all new Class II injection wells be sited in such a fashion that they inject into a formation which is separated from any USDW by a confining zone that is free of known open faults or fractures within the AOR. The applicant submitted, and EPA verified, geological information indicating the absence of faults in the injection and confining zones in the vicinity of the proposed injection well. The absence of faults in the injection and confining zones minimize the possibility of injection induced coal mine subsidence.

The "Preliminary Report on the Northstar 1 Class II Injection Well and the Seismic Events in Youngstown, Ohio Area, Ohio Department of Natural Resources, March 2012", has indicated that the seismic activity associated with the injection of fluid in the Northstar 1 well was likely due to the injected fluid coming into contact with a fault system located in deep Precambrian basement crystalline bedrock. The Blairsville-Broadtop (Mahoning River) Lineament is part of this deep Precambrian fault system approximately 7,000 feet below the Murrysville Sand injection zone and thus will not allow fluid movement into USDWs.

The United States Geologic Survey (USGS) has not recorded any seismic activity that originated in Allegheny County, Pennsylvania (Search performed via http://earthquake.usgs.gov/earthquakes/search/ on February 28, 2017). The Pennsylvania Department of Conservation and Natural Resources (PA DCNR) which includes the Bureau of Topographic and Geologic Survey, the principal organization that conducts geologic research in Pennsylvania, has not recorded any seismic activity that has originated in Allegheny County. The PA DCNR website http://www.dcnr.state.pa.us/topogeo/hazards/earthquakes/index.htm has an interactive seismicity map and catalog of all recorded seismic events in or near Pennsylvania from 1724 to present.

In addition, the National Academy of Sciences or National Research Council's report, *Induced Seismicity Potential in Energy Technologies*, National Academy Press, 2013, indicates that oil and gas production in a reservoir can assist in preventing future impacts from seismicity due to injection because of the reduction in reservoir pore pressure during the years of gas production. Penneco identified in the permit application significant gas and oil production since the late 1800s in the Murrysville Sand Formation in the vicinity of the proposed injection well.

Open faults, or transmissive faults, allow fluid to move along the fault and between formations. Non-transmissive faults, on the other hand, act as a barrier which would prevent movement of fluid along the fault and into another formation across the fault. Because not all faults act as a channel to conduct fluids, but rather as barriers, the UIC Class II requirements focus on ensuring that open faults are not present within the area an injection operation could influence.

Factors affecting fluid transmission and pore pressure

Research indicates that continuous very high rates of injection or over-pressurization of a geologic formation can contribute to the possibility of seismic activity. Conditions included in the Penneco permit were developed to prevent over-pressurization of the injection formation. The permit limits the surface injection pressure during the injection operations to 1421 psi and the bottom-hole injection pressure to 2332 psi. The surface injection pressure and the bottom-hole injection pressure limits were calculated to ensure that, during operation, the injection pressure will not propagate existing fractures or create new fractures in the formation. Limiting the pressure not only prevents the propagation of fractures that could become potential channels for fluid movement into USDWs but that could also serve as conduits for fluids to travel from the injection zone to unknown faults.

Commenters also referenced recent seismic events that have occurred in other areas of the United States including Ohio, Texas, Oklahoma, West Virginia and Arkansas that were attributed to the underground injection of fluids produced from oil and gas extraction activities. EPA recognizes that there is strong evidence that supports the underground injection of fluids as being the trigger that led to these seismic events. In some cases, these earthquakes occurred in locations where there were no known faults. However, the likely relevant factors behind these seismic events, specifically the geologic setting or the operational history of the injection wells, differ significantly from the proposed Penneco injection operation as discussed above. Scientific evidence indicates that seismic activity is most likely associated with the depth of a well, the volume and rate of injection, and the injection pressure. In these aspects, the Penneco well contrasts greatly with the wells in the known cases of induced-seismicity.

The injection zone for the Penneco injection well is the Murrysville Sand formation, a sedimentary rock layer of Lower Mississippian age, which has a higher natural porosity and greater interconnection of that pore space throughout the formation than the crystalline bedrock. The Murrysville formation is located at a depth of approximately 1800 feet below land surface at the proposed injection well site. The Precambrian crystalline basement rock in the area of the proposed injection well is located approximately 9000 feet below the proposed injection formation (Pennsylvania Geologic Survey – General Geology Open File Report 05-01.0). In the Murrysville formation the rock will more readily store injected fluid and the permeability (the available interconnected space between the grains and natural fractures in the rock) within the rock structure will allow a more uniform flow to occur throughout the formation. For these reasons, the geologic setting and reservoir characteristics of the proposed injection well are very different than the circumstances encountered in Ohio as discussed previously. For the proposed Penneco well, injection will not occur within, or flow into, the deeper Precambrian crystalline rocks.

Regarding the seismic event in Texas, a study conducted at the University of Texas at Austin's Institute for Geophysics (Proceedings from National Academy of Sciences, August, 2012), indicates that the seismic activity was likely triggered by the significant volume of fluid that was injected in a relatively short period of time. Approximately 150,000 barrels of fluid per month had been injected down a disposal well since 2006. This equals approximately 75,600,000 gallons of fluid injected yearly for about a five-year period. The proposed Penneco

injection well will be limited to a maximum of 54,000 barrels per month, one-third the monthly limit of the Texas well. Researchers studying the circumstances that led to the seismic events in both Oklahoma and Arkansas believe that over-pressurization of a nearby fault after years of injection may have led to the seismicity. Similar to what happened in Ohio, injected fluid migrated into Precambrian rocks, which in the case of those wells were found just below the injection zone, and came into contact with a fault ("Science", Volume 335, March 23, 2012). It is believed that the reduction of the frictional stress in the faults led to slippage along the faults (From the journal "Geology", co-authored by researchers with USGS and Oklahoma Geologic Survey, March 3, 2013).

In Braxton County, West Virginia, there is no definitive evidence, unlike the evidence produced for Youngstown, Ohio, that concludes injection was responsible for the seismicity in the area. However, information obtained from the West Virginia Department of Environmental Protection indicates that when the injection rate, and later the injection volume, were reduced in the injection well, seismic activity in the area ceased. The geology where this injection well was completed is also different from the geology of the proposed Penneco injection well. The injection well in West Virginia is drilled into the Marcellus Shale, which has low permeability. The last recorded seismic event in the Braxton County, West Virginia area was in January, 2012; the injection well that was suspected of causing the seismicity continues to operate.

11) Endangerment of USDWs due to injection well failures as a result of earthquakes.

Of the hundreds of thousands of injection wells operating in the United States, including those utilized for enhanced oil recovery, EPA is not aware of any case where a seismic event caused an injection well to contaminate a USDW. An inquiry through EPA regional offices did not reveal any reports of earthquakes having affected the integrity of injection wells in the cases of induced-seismicity in Ohio, Texas, Oklahoma, West Virginia or Arkansas. A number of factors help to prevent injection wells from failing in a seismic event and contributing to the contamination of a USDW. Most deep injection wells, that are classified as Class I or Class II injection wells are constructed to withstand significant amounts of pressure. They are typically constructed with multiple strings of steel casing that are cemented in place. The casing in these wells is designed to withstand both significant internal and external pressure. The American Petroleum Institute (API) (see www.api.org) and oil and gas service companies such as Halliburton Services (see Halliburton Cementing Tables, 1980), have developed industry standards for casing and cementing wells.

The proposed Penneco injection well is constructed with multiple strings of steel casing cemented in place. Furthermore, the proposed Penneco injection well will be required under the permit to be mechanically tested to ensure integrity before it is operated and will be continuously monitored during operation to ensure that mechanical integrity is maintained. This mechanical integrity testing is required by UIC regulations for all brine injection wells. If a seismic event were to occur that affected the operation and mechanical integrity of the injection well, the well is designed and monitored to detect a failure due to pressure changes in the well annulus between the long string casing and the injection tubing, and this would cause the well to automatically stop injection. See Part II.C.2 of the Permit.

12) Commenters questioned where the confining zone(s) were located and the adequacy of the confining zone above the injection zone.

The confining zone is defined as a geologic formation, group of formations or part of a formation that is capable of limiting fluid movement above an injection zone (40 C.F.R. § 146.3). Formations with low porosity and permeability, limit fluid from passing through it. A series of lower permeability shale and sandstone formations above the injection zone provide 1,400 feet of separation between the injection zone and the lowermost USDW. The Penneco application and numerous well logs from nearby wells indicates a low permeability confining layer immediately above the injection zone, the Riddlesburg Shale formation, that will serve as an initial confining formation above the Murrysville Sand injection zone. The Riddlesburg Shale formation is approximately 80-90 feet thick in the area of the injection well according to specific information in the permit application. This thickness is sufficient to prevent the movement of injected fluid into shallower geologic formations since fracturing is not permitted in the injection formation during injection. Collectively these lower permeability formations provide confinement for all injected fluids, as they did previously for the natural gas that accumulated and was subsequently produced from the Murrysville Sand formation.

The UIC regulations for Class II injection wells limit injection pressure to prevent the fracturing of the confining zone **adjacent to the** USDW. However, the Region has adopted a more protective policy when it issues permits, by establishing injection pressure limits to prevent the fracturing of the **injection formation itself**. Establishing a maximum injection pressure that prevents fracturing of the injection formation also protects the adjacent confining zones helping to assure the injection fluid remains in the intended formation . Therefore, the injection pressure limit of 1421 psi will protect the Riddlesburg Shale formation, the confining zone adjacent to the injection zone, from fracturing and thus prevent any communication with the USDWs.

13) The fluids being injected into the well toxic, hazardous and/or radioactive and should be treated and disposed of by another method. The Penneco well should be classified as a Class I hazardous waste well, not Class II.

Individual constituents contained within fluid produced from an oil or gas production reservoir could be determined to be toxic, hazardous or radioactive. However, these fluids, when generated in association with oil and gas production, are exempt from hazardous waste regulation under the UIC program because they are not classified as hazardous under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901 et seq. In December 1978, EPA proposed hazardous waste management standards that included reduced requirements for several types of large volume wastes. Generally, EPA believed these large volume "special wastes" were lower in toxicity than other RCRA regulated hazardous wastes. Subsequently, Congress exempted the wastes from RCRA Subtitle C pending a study and regulatory determination by EPA. In 1988, EPA issued a regulatory determination that the control of oil and gas exploration and production wastes under RCRA Subtitle C was not warranted, in part because other State and Federal programs, such as the UIC program, effectively manage the disposal of such wastes. Therefore, the UIC program regulates fluids produced in association with oil and gas production activities, but not as hazardous waste. Similarly, produced fluid may contain Naturally Occurring Radioactive Material or NORM. The NORM concentrations in produced fluid are typically low and do not exceed the RCRA definition of hazardous waste.

Disposal of these fluids is permissible down Class II brine disposal injection wells.

Due to the origin and chemistry of the injected fluids, Class I hazardous waste wells are subject to the strictest regulatory requirements. Some of these requirements include: long string casing cemented to the surface; two-mile area of review; post closure monitoring; mapping of the vertical and lateral limits of the USDWs; periodic external as well as internal mechanical integrity testing. These requirements do not apply to Class II wells under the UIC regulations. As explained above, EPA made a regulatory determination that brine and associated fluids need not be disposed of, or injected as, hazardous waste.

14) Underground injection is not a viable wastewater management option and is not adequately protective of USDWs. Injecting fluids under pressure may allow migration back to the surface. The assurance that the injection fluids will remain in the injection zone is lacking. One commenter referenced a 2012 ProPublica article, "Injections Wells: The Poison Beneath Us".

Commenters expressed concern that once the fluid is injected under pressure it will come back to the surface. As discussed in response #12 above, there is a confining zone, or group of geologic formations, immediately above the injection zone, the Riddlesburg Shale formation. This is a shale geologic formation which has a relatively low permeability, giving it the ability to confine and trap fluids from migrating upwards. In addition, other confining zones exist above the Riddlesburg Shale and beneath the lowermost USDW. As noted in this document, the Murrysville Sand formation, the intended injection zone, has produced natural gas in this area for many decades. It is the confinement of this natural gas that enabled successful production. The natural gas and fluids in the formation were also under pressure prior to and during production. The confining zone above the Murrysville formation, as well as other geologic factors such as the absence of faults and fractures, kept this natural gas in place. Natural gas did not migrate to the surface on its own from the Murrysville Sand. It required gas production wells to be drilled into the formation before natural gas could be recovered. Therefore, the confining zone will similarly prevent fluid movement out of the injection formation.

The public also raised the issue that the disposal of these fluids underground is not safe. All waste produced must be managed in a safe manner and best management practices are typically used by an industry or regulatory agency in determining how and where a waste can be disposed in an environmentally safe manner. If managed and operated properly, EPA believes the risk to the environment by injecting fluids deep underground can be considered safer than other methods of disposal, such as allowing them to be discharged into a stream, disposed in a landfill or treated and stored in containment pits or storage tanks. EPA also believes that the reuse or recycling of produced fluid is a sound environmental management practice. Although produced brine can be treated, recycled and reused in the hydraulic fracturing process or for the enhanced recovery of oil, the byproduct of this continued reuse of the produced fluid eventually becomes very concentrated and therefore must still be disposed of in some manner. Public and privately owned wastewater treatment facilities are unable to adequately remove many constituents found in brine, for example, chlorides and bromides. When these constituents are discharged to streams or rivers they can pose serious risk to fish and other aquatic organisms living in the stream as well as contribute to serious health effects for people who obtain their

drinking water from these streams and rivers. The UIC permitting program is designed to ensure that injection covered by the UIC permits can occur in an environmentally protective manner.

Several other factors will keep the injected fluid in place and not allow it to migrate out of the injection zone. One factor is that the permit does not allow the injection pressure to exceed the injection formation fracture pressure and thereby prevents fracturing that could allow fluid to migrate out of the injection zone. In addition, no other artificial penetrations (e.g., abandoned wells) of the injection zone were identified within the AOR. The absence of any other artificial penetration into the injection zone within the AOR will prevent injection fluid from migrating out of the injection zone and into USDWs. The permit also requires a fluid level monitoring well which will provide real-time pressure measurements within the AOR.

15) What is EPA's role in inspecting this well during operation?

EPA has direct implementation authority for the UIC program in the Commonwealth of Pennsylvania. Therefore, in addition to permitting, EPA also will be responsible for inspecting the Penneco injection well and enforcement of the permit requirements for the operation of the well. EPA has a team of inspectors, including one full time inspector responsible for inspecting Class II underground injection wells. At least one EPA inspector will be present to witness the well mechanical integrity tests and EPA will, at a minimum, inspect the well during operation on an annual basis. EPA reviews the operator's annual report including continuous monitoring reports of pressure and volumes injected. Any non-compliance is subject to enforcement action as appropriate.

16) The company is responsible for self-reporting to EPA. This does not seem like an acceptable way for EPA to ensure that the well operates properly. Penneco Oil Company has a poor compliance record and a history of violations and is already injecting into the well without a permit.

The UIC regulations are similar to most other federal regulations in that they require self-monitoring and reporting to a state or federal agency. EPA expects all operators to comply with the regulatory requirements as well as their permit requirements. An operator's failure to comply with the permit, including accurately monitoring and reporting to EPA would subject the operator to possible civil or criminal penalties or both. EPA inspects every Class II disposal well in Pennsylvania at least annually. EPA's inspection of injection well facilities and review of annual reports helps assure operator compliance and supplements self-reporting.

Penneco has no operational or permitted injection wells in Pennsylvania. According to an EPA review of the PA Department of Environmental Protection, Oil and Gas Compliance Report http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/OG_Compliance, from June 1, 2005 through September 12, 2017, Penneco Oil Company production facilities were inspected 1,657 times. Forty of these inspections identified violations with a total of 58 violations and 46 enforcement actions. Penneco operates approximately 920 production wells in Pennsylvania.

The Sedat Well #3A currently has an active production well permit issued by the PADEP. Production wells commonly require routine maintenance and well re-work. Penneco recently acidized or cleaned Sedat Well #3A. Well treatment when fluids are placed into the well, including hydraulic fracturing, stimulation and cleaning are not subject to EPA UIC program requirements.

17) Well casing does not last forever. What is the lifetime maintenance plan for this well?

EPA conducted a thorough evaluation of the Sedat Well #3A completion report including well construction information and well logging, casing and cementing records. The permit requires mechanical integrity testing. EPA reviews the cement bond logs to evaluate whether the well has been properly cemented to prevent injected fluid from flowing through the wellbore outside the casing. The mechanical integrity test involves increasing the pressure in the annulus (the space between the injection tubing and long string casing) ten percent above the maximum injection pressure authorized in the permit. The pressure must be maintained over a period of 30 minutes for the well to have mechanical integrity. This tests the mechanical integrity of the long string casing, tubing and packer to determine whether there are any leaks. The permit requires mechanical integrity testing be performed every five years and after any repair, modification, and rework of the injection well. If possible leaks are indicated, the test may also include an evaluation of whether fluid movement is occurring outside the casing. Under the terms of the permit, EPA can request the permittee to demonstrate mechanical integrity at any time.

Furthermore, Part II.B.2 of the final permit requires continuous monitoring of the injection well for injection pressure, annular pressure and injected volumes. This will enable the operator as well as EPA to determine whether the integrity of the well's long string casing, tubing and packer are compromised over the course of operation. The monitoring will be designed to detect pressure changes. Annular pressure monitoring requires that the well's annulus pressure be set at a positive pressure lower than the injection pressure. If a leak were to develop in the tubing or packer, the annular pressure would increase significantly. If the well experiences a leak in the long string casing, the pressure in the annulus would decrease significantly. Either situation would automatically trigger the well to shut down and cease operating. This would constitute a mechanical integrity failure of the well, and in accordance with Part II.C.2 of the final permit, the operator would be required to cease injection immediately.

Finally, when the operator no longer wants to operate the injection well, it must be permanently plugged and abandoned in accordance with Part II.D.9 and Part III.C of the final permit, which requires that the permittee plug the well in such a manner that plugging does not allow movement of fluids into or between underground sources of drinking water. Since the mid-1980s, several thousand Class II wells in Region 3 have been successfully plugged in accordance with the regulatory requirements. Penneco has submitted a plugging and abandonment plan on EPA Form 7520-14 which has been approved by EPA and is incorporated into the permit. The plugging plan is to be accomplished by one of the methods mandated by the UIC regulations at 40 C.F.R. § 146.10. This plan is provided in Attachment 1 of the final permit.

18) Penneco must provide financial resources to plug the well should a well failure occur or useful life of the well ends. Several commenters questioned who would be responsible for ground water remediation if impacts occur.

Under the UIC regulations, owners and operators of injection wells are required to demonstrate financial responsibility for the purpose of properly plugging and abandoning the injection well when the operation ceases and the well is no longer used for injection. The cost of plugging a well depends, among others things, upon the depth of the well and how the well was constructed. Penneco submitted an estimate of $12,515 from an independent plugging contractor on the cost of plugging the well, as well as a letter of credit with a standby trust agreement for the plugging and abandonment of the injection well. EPA Region III reviewed and approved this submission. The estimated plugging cost for the Penneco injection well falls within the range of estimated costs for plugging other Class II-D disposal wells in Pennsylvania. Those plugging estimates range from $10,000 to $75,000, with an average of approximately $32,000. The permit incorporates the requirement that Penneco maintain financial assurance in the amount of the estimate through a letter of credit. (See Part III.D). EPA can require the permittee to adjust the cost estimate and the financial assurance instrument as necessary. See 40 C.F.R. § 144.52.

Although a separate issue from the financial responsibility required for plugging and abandonment, the public also asked whether the operator is required to set money aside to remediate any contamination of their drinking water if the injection operation fails and allows fluids to migrate into a USDW. The operator is not required to set money aside for ground water remediation. However, EPA does have additional authorities under the Safe Drinking Water Act (SDWA) if endangerment to USDWs should result from injection activities.

19) Wastewater injected in the well should be more fully characterized or should be monitored for other parameters.

EPA believes that the conditions found in Parts II, C.3 and C.4 of the permit, are sufficient to adequately characterize and monitor the wastewater for injection purposes. The purpose of this monitoring is to verify that the fluids injected in the well are the type of fluids authorized in the permit. Shallow ground water and drinking water wells, when monitored, are typically tested for many of the same parameters required by the permit. Therefore, if there is evidence of shallow ground water contamination, those results can be compared against the injection fluid analysis to determine whether the injection well is the cause of that contamination. For example, chloride, one of the parameters for which the permit requires monitoring, can be found in drinking water and it can be found in the fluid proposed for injection. In shallow ground water used for drinking water, chloride values are fairly low, and can commonly be found at less than 500 mg/l. Injection fluid often contains chlorides in excess of 10,000 mg/l and sometimes as high as 300,000 mg/l. If shallow drinking water were to become contaminated by the injection fluid, there would be a significant change that could be observed relatively quickly through the monitoring of chloride. In addition, the permit will require monitoring parameters, such as Total Organic Carbon (TOC), that are aggregate surrogates for multiple compounds that are not individually listed in the permit monitoring requirements. In the case of TOC, monitoring for this parameter identifies the presence of various organic compounds found in produced fluid from oil and gas operations. Produced fluid will typically exhibit a much lower TOC value than a RCRA hazardous waste. Therefore, an elevated TOC test result would cause

EPA to require further investigation.

A more extensive characterization might be appropriate if this wastewater were disposed in a different manner such as directly into a stream. However, this wastewater will be injected far below land surface into an existing gas bearing formation similar in nature to where the wastewater was generated. Moreover, EPA will periodically sample the injection fluid from the Penneco injection operation. If EPA found that Penneco injected fluids other than produced fluids associated with oil and gas production, it would be in violation of the permit and subject to enforcement action.

20) What happens when the permit expires?

The UIC Class II regulations allow permit issuance for a ten-year period. See 40 C.F.R. § 144.36(a). Before the end of that ten-year period, Penneco may request EPA to reissue the permit by submitting a new application. In that event, EPA will review the history of the Penneco operation to determine whether to reissue the permit. EPA's tentative decision of whether to reissue or deny the permit for an additional term is subject to the same public notification and public comment process as an initial permit.

If Penneco decides not to continue the injection operations at the end of the permit term, it must plug and abandon the well in accordance with the permit requirements, prior to the expiration of the permit.

21) A commenter was concerned that the injection fluid may migrate beyond the established AOR.

The purpose of the AOR is to establish a specific area for possible corrective action. It is based on potential pressure build-up in the injection formation over the life of the permit. It is not an established boundary for the movement of injection fluid.

22) This EPA UIC permitting decision requires an independent, third party review.

EPA believes that a comprehensive review of all technical and legal matters relevant to this permitting decision were conducted and a thoroughly informed decision was reached. The process for having an independent review by the Environmental Appeals Board follows:

Federal Underground Injection Control Program
Permit Appeals Procedures

The provisions governing procedures for the appeal of an EPA permitting decision are specified at 40 C.F.R. Part 124.19. (Please note that the changes to this regulation became effective on March 26, 2013. See 78 Federal Register 5281, Friday, January 25, 2013.) Any person who commented on the draft permit, either in writing during the comment period or orally at the public hearing, can appeal the final permit by filing a written petition for review with the Clerk of the EPA Environmental Appeals Board (EAB). Persons who have not previously provided comments are limited in their appeal rights to those points which have been changed between the draft and final permits. Appeals may be made by citizens, groups, organizations, governments and the permittee within this procedural framework.

A petition for review must be filed within thirty (30) days of the date of the notice announcing EPA's permit decision. This means that the EAB must receive the petition within 30 days. (Petitioners receiving notice of the final permit by mail have 3 additional days in accordance with 40 C.F.R. § 124.20(d).) The petition for review can be filed by regular mail sent to the address listed below with a copy sent to EPA Region III at the address listed below.

Environmental Appeals Board
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue N.W.
Mail Code 1103M
Washington, DC 20460-0001

U.S. Environmental Protection Agency
Region III Ground Water & Enforcement Branch (3WP22)
Water Protection Branch
1650 Arch Street
Philadelphia, PA 19103

See the Federal Register notice cited above or the EAB website:
http://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/) for how to file with the EAB electronically or by hand delivery.

The petition must clearly set forth the petitioner's contentions for why the permit should be reviewed. It must identify the contested permit conditions or the specific challenge to the permit decision. The petitioner must demonstrate the issues raised in the petition had been raised previously during the comment period or at the hearing. If the appeal is based on a change between the draft and final permit conditions, the petition should state so explicitly. The petitioner must also state whether, in his or her opinion, the permit decision or the permit's conditions appealed are objectionable because of:

1. Factual or legal error, or

2. The incorporation of a policy consideration which the EAB should, at its discretion, review.

If a petition for review of this permit is filed, the permit conditions appealed would be deemed not to be in effect pending a final agency action.

Within a reasonable time of receipt of the Appeals Petition, the EAB will either grant or deny the appeal. The EAB will decide the appeal on the basis of the written briefs and the total administrative record of the permit action. If the EAB denies the petition, EPA will notify the petitioner of the final permit decision. The petitioner may, thereafter, challenge the permit decision in Federal Court. If the EAB grants the appeal, it may direct the Region III office to implement its decision by permit issuance, modification or denial. The EAB may order all or part of the permit decision back to the EPA Region III office for reconsideration. In either case, a final agency decision has occurred when the permit is issued, modified or denied and an Agency decision is announced. After this time, all administrative appeals have been exhausted, and any further challenges to the permit decision must be made to Federal Court.